The Welding Engineer

Reg. U. S. Pat. Office

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TORCHWELD
CUTTING AND WELDING
TORCHES

You could get along without your 'phone—but you wouldn't, because it helps you do business faster, easier and better.

Your business neighbors feel the same about TORCHWELD APPARATUS; they could put up with the troubles experienced with their former apparatus—but they WON'T.

Write for booklet explaining each TORCHWELD feature; it will tell what can be accomplished with our apparatus.

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Fulton and Carpenter Streets, Chicago

High grade welding and cutting apparatus. Portable and generator outfits. Welding rods, welding fluxes, supplies and accessories.

Pittsburgh Detroit Cleveland New York Memphis Dallas Minneapolis

THE ANSWER TO RISING PRODUCTION COSTS

NOWADAYS most every manufacturer of metal products employs Oxwelding to some extent.

The most efficient plants are successfully meeting the problem of mounting production cost by greater and greater use of the Oxy-Acetylene Process.

Oxwelding and cutting blowpipes make possible many a profitable short cut—proven production methods that will give you larger output at less cost.

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NEWARK, N. J. CHICAGO LOS ANGELES

World's Largest Maker of Equipment for Oxwelding and Cutting Metals.

O-502

ATTENTION

We Want Several

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For Our

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Our instruments are used in numerous first-class welding and cutting shops with most gratifying results.

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For Preheating in Connection With Welding

Crack developed in ½" brass sleeve covering 24" diameter x 204" face cast iron roll was preheated with the above burner, then welded. Job was completed in five hours. Prior to use of Hauck Preheater, it was impossible to do this class of work satisfactorily.

Hauck Preheaters assure of successful preheating at half the former cost.

Hauck Compressed Air Preheaters light instantly. Burn fuel, crude or kerosene oil. Light in weight; easy to handle.

Write for details about trial proposition

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Quality—The Best
Prices—Right
Delivery—From Stock

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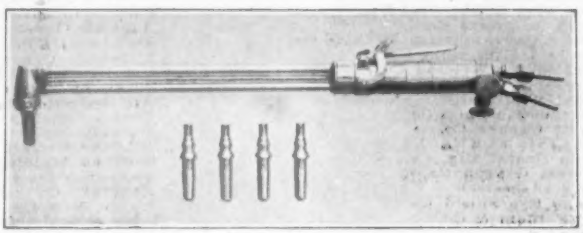

THE "K-G" TORCH

FOR

CUTTING RIVETS, BOILER TUBES, PLATE CUTTING and GENERAL WORK

CANNOT BE BEATEN

All we ask is an unbiased comparison and test. Complete equipment and all accessories and supplies for gas welding and cutting.

OXYGEN—ACETYLENE

K-G Welding & Cutting Co.

Incorporated

556 West 34th St., New York City

Buyers' Index

Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

ACETYLENE (Compressed in Cylinders)
Commercial Acetylene Welding Co.
Universal Oxygen Co.
Prest-O-Lite Co.

ACETYLENE (Dissolved)
Linde Air Products Co.

ACETYLENE CYLINDERS

ACETYLENE GENERATORS
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Davis-Bournonville Co.
The Alexander Milburn Co.
Oxweld Acetylene Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.

ALUMINUM FILLER RODS
Air Reduction Sales Co.
Bermo Supply Co.
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The Imperial Brass Mfg. Co.
Hauck Mfg. Co.
Imperial Brass Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Mach. Co
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.

ALUMINUM FLUX
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American Flux Co.
Air Reduction Sales Co.
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Burdett Oxygen Co.
Kentucky Oxygen-Hydrogen Co.
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Davis-Bournonville Co.
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Hauck Mfg. Co.
Imperial Brass Co.
Morey Flux & Chemical Co.
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Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.

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Imperial Brass Co.
F. H. Wheeler Mfg. Co.

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Superior Oxy-Acetylene Machine Co.
United States Welding Co.
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Kentucky Oxygen-Hydrogen Co.
Federal Brass Works.
Hauck Mfg. Co.
Harris Calorific Co.
Smith's Inventions, Inc.
The Alexander Milburn Co.
Torchweld Equipment Co.

BOOKS (Relating to Welding)
The Welding Engineer

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Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
Standard Mfg. Co.
Torchweld Equipment Co.
Universal Oxygen Co.

BRASS SPELTER WIRE
Air Reduction Sales Co.
Burdett Oxygen Co.
Universal Oxygen Co.
Torchweld Equipment Co.

BRAZING COMPOUND
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BRAZING OUTFITS
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Hauck Mfg. Co.
Imperial Brass Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.

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Bermo Supply Co.
Davis-Bournonville Co.
Kentucky Oxygen-Hydrogen Co.
The Imperial Brass Mfg. Co.
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Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.

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Union Carbide Sales Co.

CARBON (Blocks, Paste, Etc.)
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Kentucky Oxygen-Hydrogen Co.
Harris Calorific Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
The Alexander Milburn Co.
Oxweld Acetylene Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Mach. Co.
Torchweld Equipment Co.
Universal Oxygen Co.

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Bermo Supply Co.
Burdett Oxygen Co.
Bierman-Everett Fdy. Co.
Cortland Welding Compound Co.
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Kentucky Oxygen-Hydrogen Co.
Hauck Mfg. Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
Memphis Welding Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
Standard Mfg. Co.
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.

COPPER FLUX
American Flux Co.

CYLINDERS
Wm. Wharton, Jr., & Co.

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Gibb Instrument Co.
Lincoln Elec. Co.
National Elec. Co.
Westinghouse Elec. & Mfg. Co.

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International Oxygen Co.
The Electrolabs Co.
Universal Oxygen Co.

ELECTROLYTIC OXYGEN AND HYDROGEN GENERATING EQUIPMENT
Air Reduction Sales Co.
Burdett Oxygen Co.
The Electrolabs Co.
International Oxygen Co.
Universal Oxygen Co.

FILLER RODS (Aluminum)
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Imperial Brass Co.
International Oxygen Co.
Kentucky Oxygen-Hydrogen Co.
Torchweld Equipment Co.
United States Welding Co.

FILLER RODS (Swedish Iron)
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The Imperial Brass Mfg. Co.
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Torchweld Equipment Co.
Superior Oxy-Acetylene Machine Co.
United States Welding Co.
Universal Oxygen Co.

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Memphis Welding Co.

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Universal Oxygen Co.

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Universal Oxygen Co.

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International Oxygen Co.
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Hauck Mfg. Co.

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Buffalo Dental Mfg. Co.
Davis-Bournonville Co.
Kentucky Oxygen-Hydrogen Co.
International Oxygen Co.
Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.

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K-G Welding & Cutting Co.
Hauck Mfg. Co.
International Oxygen Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.

HYDROGEN GENERATING APPARATUS
Air Reduction Sales Co.
Burdett Oxygen Co.
Electrolytic Oxy-Hydrogen Laboratories, Inc.
International Oxygen Co.
Universal Oxygen Co.

Davis-Bournonville Co.

Long ago recognized the trinity of welding success—the three factors of dependable autogenous welding:

1. Efficiency of apparatus.
2. Proficiency of welder.
3. Quality of filler rod and flux.

Davis-Bournonville oxy-acetylene torches and regulators are the world's standard of excellence. Proficient welders prefer them everywhere.

Davis-Bournonville welding supplies are the best that can be made in the light of present knowledge of metal fusion and flux action. Proficient welders use them everywhere.

Are you using D-B Special rods for steel, D-B Atlas sticks for cast iron, D-B Peerless sticks for aluminum, D-B Gem sticks for brass and bronze, Atlas scaling powder on cast iron, Marvel Flux on brass and bronze, Dee-Bee flux on cast aluminum and Napolitan flux on sheet aluminum? They may cost more but they are worth more.

Welding supplies and accessories are carried in stock by all branch stores in the principal cities.

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CALLAO
CHICAGO
CINCINNATI
CLEVELAND
DALLAS
DETROIT
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DAVIS
APPARATUS
DAVIS-BOURNONVILLE CO. N.Y.

MANILA
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MONTREAL
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SEATTLE
TORONTO

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KEROSENE PREHEATING TORCHES
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NEEDLE VALVES
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Torchweld Equipment Co.

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NITROGEN
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Gas Products Assn.
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Superior Oxy-Acetylene Machine Co.

OXY-ACETYLENE PROCESS
Linde Air Products Co.

OXYGEN (Compressed in Cylinders)
Air Reduction Sales Co.
Burdett Oxygen Co.
Gas Products Ass'n.
International Oxygen Co.
The Linde Air Products Co.
Swift & Co.
Universal Oxygen Co.

OXYGEN AND HYDROGEN GENERATING EQUIPMENT
Burdett Oxygen Co.
The Electrolabs Co.
Gas Products Assn.
International Oxygen Co.
Universal Oxygen Co.

OXYGEN CYLINDERS

PIPE WELDING
Metal & Thermit Corp.

PHOTOGRAPHS
Chicago Architectural Photographing Co., (Specialists in photographs relating to the welding industry)

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PRESSURE GAUGES
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Federal Brass Works.
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Harris Calorific Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
National Gauge & Eq'p't Co.
Oxweld Acetylene Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
U. S. Gauge Co.
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.

REGULATING VALVES (Acetylene)
Air Reduction Sales Co.
The Bastian-Blessing Co.
Bermo Supply Co.
Burdett Oxygen Co.
Davis-Bournonville Co.
Federal Brass Works.
Hauck Mfg. Co.
Harris Calorific Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
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Oxweld Acetylene Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.
Universal Regulator Co.

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Bermo Supply Co.
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Harris Calorific Co.
International Oxygen Co.
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Universal Regulator Co.
Harris Calorific Co.
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Smith's Inventions, Inc.
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Universal Oxygen Co.

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Smith's Inventions, Inc.
Torchweld Equipment Co.
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Harris Calorific Co.
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International Oxygen Co.
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Oxweld Acetylene Co.
The Prest-O-Lite Co.
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Westinghouse Electric & Mfg. Co.

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Bermo Supply Co.
Burdett Oxygen Co.
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Harris Calorific Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Kentucky Oxygen-Hydrogen Co.
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Oxweld Acetylene Co.
Prest-O-Lite Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
The Thermalene Co.
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.

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Air Reduction Sales Co.
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Bermo Supply Co.
Burdett Oxygen Co.
Davis-Bournonville Co.
Federal Brass Works.
The Imperial Brass Mfg. Co.
K-G Welding & Cutting Co.
Kentucky Oxygen-Hydrogen Co.
The Alexander Milburn Co.
Oxweld Acetylene Co.
Prest-O-Lite Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
The Thermalene Co.
United States Welding Co.
Universal Oxygen Co.

TORCHES (Oxy-Hydrogen Cutting)
Air Reduction Sales Co.
The Bastian-Blessing Co.
Harris Calorific Co.
Bermo Supply Co.
Burdett Oxygen Co.
Davis-Bournonville Co.
Federal Brass Works.
Harris Calorific Co.
International Oxygen Co.
Kentucky Oxygen-Hydrogen Co.
Prest-O-Lite Co.
Smith's Inventions, Inc.
Superior Oxy-Acetylene Machine Co.
Universal Oxygen Co.
The Alexander Milburn Co.
The Imperial Brass Mfg. Co.
Torchweld Equipment Co.
Oxweld Acetylene Co.

TORCHES (Oxy-Hydrogen Welding)
Air Reduction Sales Co.
The Bastian-Blessing Co.
Bermo Supply Co.
Kentucky Oxygen-Hydrogen Co.
Burdett Oxygen Co.
Buffalo Dental Mfg. Co.
Davis-Bournonville Co.
Federal Brass Works.
Harris Calorific Co.
International Oxygen Co.
The Imperial Brass Mfg. Co.
The Alexander Milburn Co.
Oxweld Acetylene Co.
Prest-O-Lite Co.
Smith's Inventions, Inc.
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.

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Oxweld Acetylene Co.
Superior Oxy-Acetylene Machine Co.
Torchweld Equipment Co.
United States Welding Co.
Universal Oxygen Co.
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Air Reduction Sales Co.
Burdett Oxygen Co.

VALVES (For Oxygen Cylinders)
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WELDING APPARATUS
See also "Torches."

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Wilson Welder & Metals Co.

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Westinghouse Elec. Mfg. Co.

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International Oxygen Co.
The Imperial Brass Mfg. Co.
F. H. Wheeler Mfg. Co.

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Air Reduction Sales Co.
Burdett Oxygen Co.
The Imperial Brass Mfg. Co.
Chicago Eye Shield Co.
International Oxygen Co.
Torchweld Equipment Co.

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Wilson Welder & Metals Co.

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Air Reduction Sales Co.
Burdett Oxygen Co.
International Oxygen Co.
Universal Oxygen Co.

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Air Reduction Sales Co.
Bierman-Everett Fdy. Co.
Burdett Oxygen Co.
Kentucky Oxygen-Hydrogen Co.
The Imperial Brass Mfg. Co.
Federal Tool & Alloy Steel Corp.
International Oxygen Co.
Oxweld Acetylene Co.
Page Steel & Wire Co.
Torchweld Equipment Co.

ALPHABETICAL INDEX TO ADVERTISERS

A
Air Reduction Sales Co. 67
Anti-Borax Compound Co. 15
American Flux Co. 56
Alloy Products Co. 66
Atlas Foundry Co. 66

B
Bastian-Blessing Co., The 34-35
Bermo Supply Co. 66
Bierman-Everett Fdy. Co. 3
Buffalo Dental Mfg. Co. 9
Burdett Oxygen Co. 20

C
Canada Carbide Sales Co. 16
Cave Welding Co. & Mfg. Co. 57
Chicago Eye Shield Co. 61
Commercial Acetylene Supply Co. ..Back Cover
Cortland Welding Compound Co. 14
Wm. Cramp & Sons 9

D
Davis-Bournonville Co. 5-18

E
The Electrolabs Co. 55
Electric Arc Welding & Cutting Co. 47

F
F. D. Farnum & Co. 65
Federal Brass Works 17
Federal Tool & Alloy Steel Corp. 59

G
General Electric Co. 10-11
Giest Mfg. Co. 8
General Welding & Equipment Co. 33
Gas Products Assn. 39
Gibb Instrument Co. 21
M. C. Green 18

H
Harris Caloric Co. 20
Hydrex Engineering Co. 3
Hauck Mfg. Co. 3

I
Imperial Brass Mfg. Co. 51
International Oxygen Co. 65

K
Kentucky Oxygen-Hydrogen Co. 63
K-G Welding & Cutting Co. 3

L
Linde Air Products Co. 22
Lincoln Electric Co. 43
L. Lawrence & Co. 53
Lincoln Electric Co. 37
L. Lawrence & Co. 45

M
Metal & Thermit Corp. 19
Memphis Welding Co. 51
The Alexander Milburn Co. 41
Morey Flux & Chemical Co. 66
Modern Engineering Co. 59

N
National Carbon Co. 56
National Gauge Eqpt. Co. 59

O
Oxweld Acetylene Co. 2

P
Page Steel & Wire Co. 37
Portland Brazing Machine Works. 18
The Prest-O-Lite Co., Inc. 43

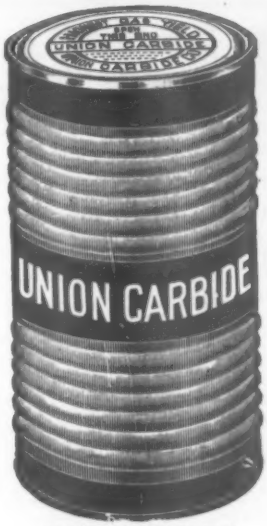
R
Rochester Welding Works. 18
John A. Riebling's Sons Co. 14

S
Smith's Inventions, Inc. 15
Superior Oxy-Acetylene Machine Co. 61
Sorenson, C. 51
Southern Welding Machine Co. 18
Swift & Co. 17
Standard Mfg. Co. 56
Star Mfg. Co. 66

T
The Thermalene Co. 66
Torchweld Equipment Co. ..... Front Cover

U
Union Carbide Sales Co. 7
U. S. Gauge Co. 8
United States Welding Co. 15-21-57-65
Universal Oxygen Co. 47
Universal Regulator Co. 66

W
Westinghouse Elec. Mfg. Co. 12
F. H. Wheeler Mfg. Co. 9
Wm. Wharton, Jr., & Co., Inc. 47



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Contractors' Flare Lights, Torches and Private and Municipal Lighting Plants

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Fort Smith—15 N. 4th St.
CALIFORNIA
Fresno—932 H St.
Los Angeles—639 Gibbon St.
Sacramento—1523-31 Front St.
San Diego—326-336 Fifth St.
San Francisco—Kohl Building.
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Denver—Nineteenth and Wazee Sts.
CONNECTICUT
Hartford—412 Trumbull St.
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Jacksonville—615 W. Bay St.
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Salina—154 So. 5th St.
Wichita—535-543 West Douglas Ave.
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Louisville—126 E. Main St.
Middlesboro—1701 Cumberland Ave.
LOUISIANA
New Orleans—819-21 Julia St.
MAINE
Portland—11 Exchange St.
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Baltimore—19 E. Lombard St.
Cumberland—1 N. Liberty St.
Salisbury—Opp. Fulton Station.
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Boston—(See Cambridge "A.")
Cambridge—241 Albany St.
Springfield—Napier St.
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Detroit—Grand River and Lorain Ave.
Grand Rapids—500 Shawmut Ave., N. W.
Hancock—First National Bank Bldg.
Iron Mountain—215 E. A St.
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Muskegon—303 W. Western Ave.
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Sault Ste. Marie.
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Minneapolis—334 N. First St.
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Vicksburg—1312 Washington St.
MISSOURI
Kansas City—1316-1318 W. Eighth St.
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St. Louis—(See East St. Louis, Ill.)
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Omaha—1007-9-11 Jones St., Union Sta. P. O.
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CONTENTS

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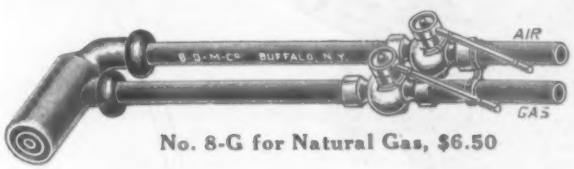

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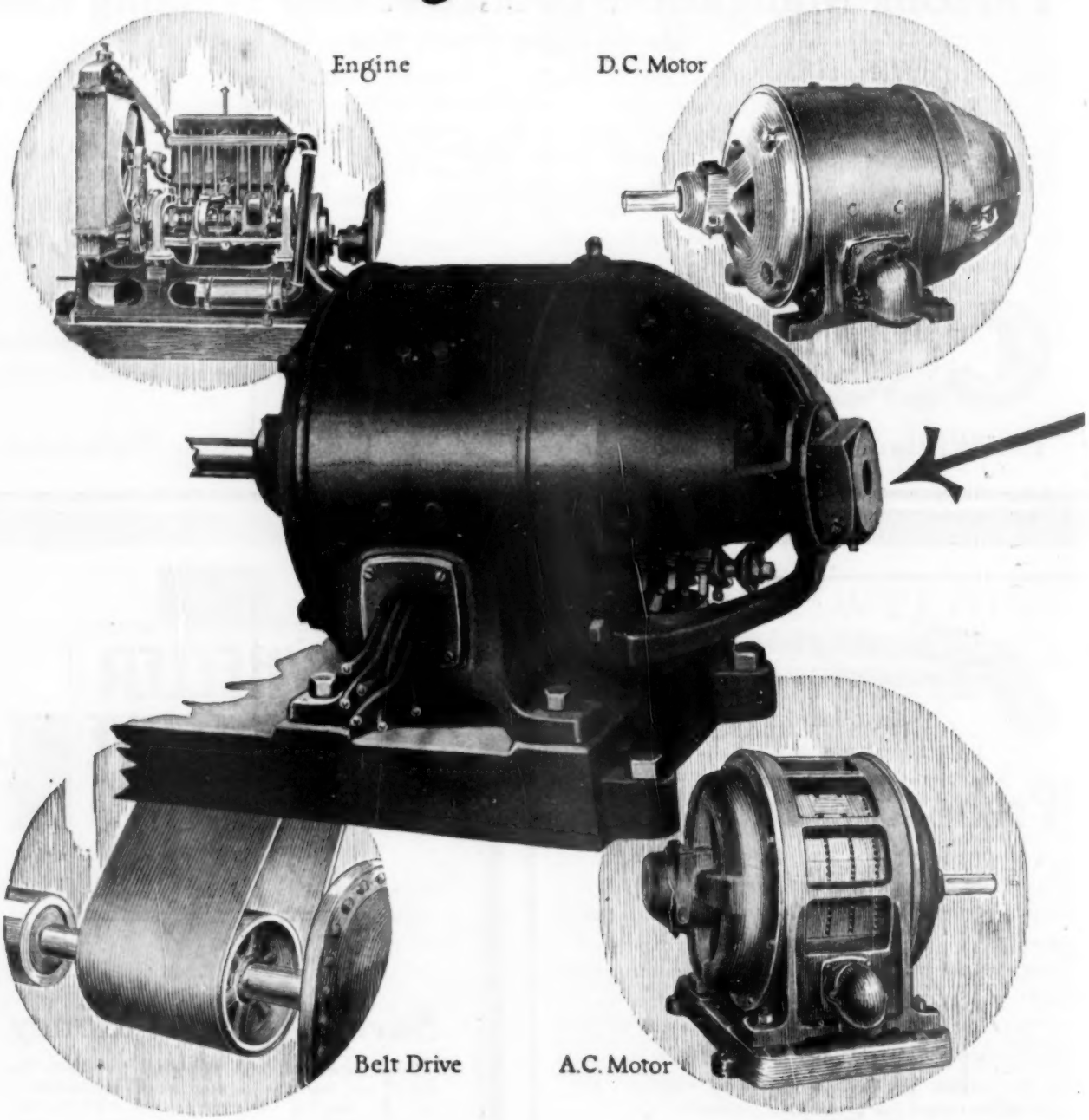

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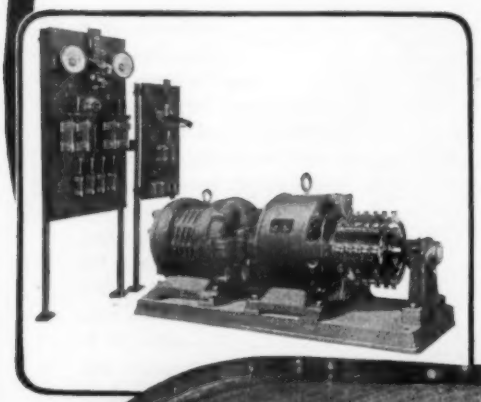

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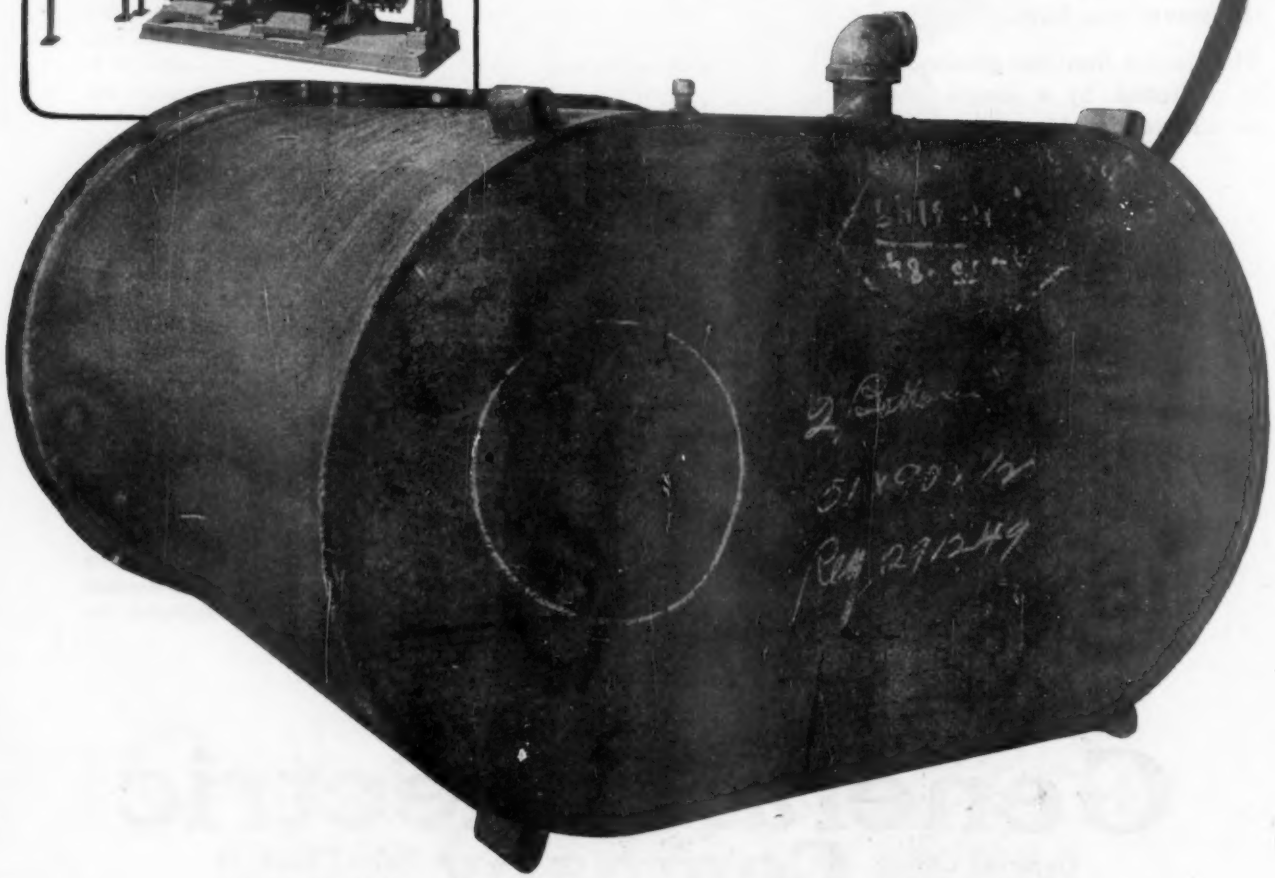

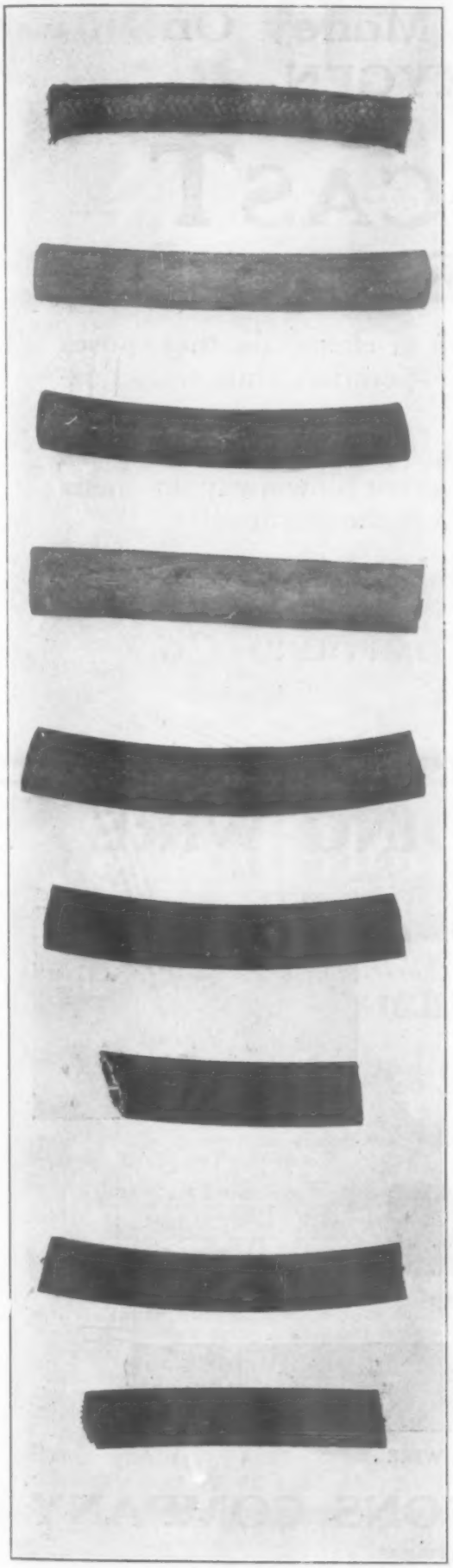

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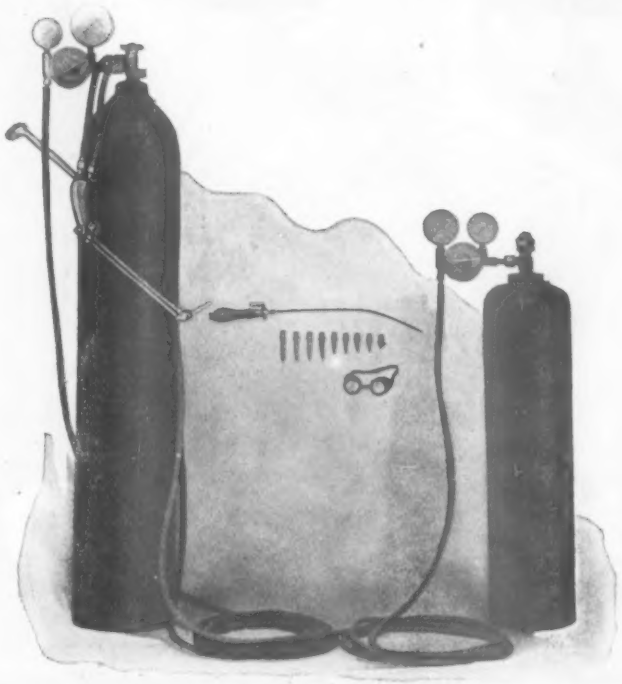

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CAST IRON WELDING *and* EXPANSION

By G. Bernard Julian

The short article by D. L. Matelski in *The Welding Engineer* for November is interesting, to say the least.

He says that Cast Iron is the most difficult of the metals to weld, which is doubtful. In my opinion, Cast Iron is the most interesting of the metals to work on, and I'd venture to say there is no welding engineer or expert who can invariably predict what will happen if a complicated casting, heated and welded at a point, the expansion from which there is no outlet, and which, according to all the hard and fast rules of Cast Iron welding, should crack.

The writer has made a weld in the side panel of a cylinder-block in a speedboat, without removing the engine from any of the fittings from the engine; merely packing the bearings around with wet asbestos, and proceeding as though the work were to be done on a vertical steel plate.

The work was done under the direction of a foundry superintendent, who, although he had no working knowledge of oxy-acetylene welding, gas directions to heat this place and that, after the actual welding was completed; so as to compensate for the expansion, and consequent contraction from the heat of the weld.

I have had a long and varied experience as a welder, and have never seen this even tried before, either in our largest and best known welding shops, or in those in England and the Continent.

But when you figure it out, isn't it quite possible that we have been playing "safety first," in pre-heating and reheating castings all over, without taking the trouble to study it, with a view to ascertaining just where the strain is going to come, and so by applying the heat only where it is needed, save ourselves oodles of time and fuel, to say nothing of the trouble in handling a casting that is heated all over? I think this subject of what might be called "Compensated Heating" would bear further going into.

The aforementioned foundry official remarked—apropos of my warning that making a gas weld at that point in a cylinder, without preheating, was unprecedented—that "acetyelene welding is only in its infancy."

That statement, to we who have made our living at it for years, will appear to border on the humorous. We have seen the process improved with all manner of modern scientific appliances, and adapted to work that even as recently as 1900 was accomplished by old-fashioned methods that seem laughable now; and we go smugly on our way, assuming that "what we don't know about welding, is torn out of the book." It is quite possible that the process, as regards preparing for and facilitating the actual welding of castings, is really only in its infancy.

No doubt, later on, let us hope not much later, we may have developed a system for heating castings only where they need it; that will do away with the bothersome methods, now considered ultra-modern, of securing our welds against cracking.

Mr. Matelski complains of the difficulty experienced in eliminating, or avoiding hard spots, and attributes their presence in the weld, to deposits at the edge of the weld, of dirt, sand, etc.; dirt or sand, if on top of the iron, would be easily chipped off, and would not affect the ductility of the metal; while if the foreign substance were imbedded in the metal, it would still be free from hard spots, as you cannot very well fuse iron to dirt or sand. The only result of dirt or sand in a weld is a so-called blow-hole directly over the foreign matter.

The very fact that the hard spot is always at the edge of the weld, would indicate even to a novice, that it is due to uneven heat. The writer is employed in a foundry producing automobile cylinders of a single type; repairs are made on an average of 125 cylinders a day of nine hours. These are finished, ready to be assembled, which precludes pre-heating. As the welds are worked down to a surface with a file, it is imperative that there be no hard spots; even the number to be salvaged in the nine hours makes it impossible to make any great preparations, as only one welder is employed at it. Yet every cylinder is welded, regardless of where the weld is to be made, often 1/32-inch of metal added to the entire bottom face; on small welds, to insure uniform softness, the surface surrounding the weld for two inches is heated to a cherry red, thus transferring the hard spot, which is present more or less at the edge of every weld made cold—to the finished surface.

It might be mentioned also, that these hard spots are, as a rule, entirely superficial, a sort of case-hardening of the metal in one spot.

Mr. Matelski remarks that warpage is caused by overheating or not heating enough. Most of the troubles experienced with cylinder blocks, in this respect, are due to heating, no doubt. Really there is no place on a cylinder, with the exception of the bore and the jacket, that will not stand a weld without preheating.

Welders are too conservative, too ready to rely on what the other fellow has learned for him. Ever since the first cast iron expansion problem confronted us, castings have been preheated. If a casting is so constructed as to have a single angle or projection, it is thrown into the fire, or laid in front of a gas-blower, regardless of where the fracture is situated.

"Progress inexorably demands experiment," skepticism, challenge, should be the attitude of a man who intends to be a real welder. Most of the warpage complained of in cylinders is because of preheating rather than in spite of it. A little common sense and logical reasoning, studying of each job, would teach us things that would in time accord welding the dignity of an art, rather than a trade.

With the proper heat, and its proper application, there should be no blow-holes, either on the surface or in the interior of the weld. One practise that is very detrimental, is going back over a weld after you have finished it, in making a running weld along a crack or seam in cast iron. It is the habit of some welders to go back over every few inches and stir it up again, by way of ascertaining if what he has done is free from holes. It is, apparently, so he goes on; but after the first welding, the metal cools until black, then the heat is again applied, but only enough to make the surface iron flow. Then it is allowed to settle back on the comparatively cold iron underneath, producing the results attributed by Mr. Matelski to a too localized heat. The weld should be made to the left, assuming the welder to be right-handed. In this way you are using all of your heat, thereby doing a quicker job, and the

metal will automatically pile up behind the tip, free from holes.

As to the relative merits of grinding the edges of broken parts, and running or washing out the old metal; that the latter method is preferable will be readily seen. If the break is irregular and the part such as to acquire accuracy in joining, what more natural, or more convenient method could be suggested than to set the parts together, tack them so, and wash out a ditch the length of the weld. Whereas, if the parts are ground to a bevel, you require blocks, skims, squares and levels to set them up, prior to welding.

We all make mistakes and most of us profit by them, but such things as blowholes, hardspots and the like, should be, and are an unknown quantity in the work of a welder. By that I mean, not a beginner, nor a metal-melter, nor the thousands who break in in sheet-metal shops, and remain there years on repetitive work, and who call themselves welders. Welders, in a strict sense, are mighty scarce, in spite of all the Army is said to have made during the war.

There is a lot to be said about welding cast-iron, but there is no use saying it. Good welders know it, and those who would become good welders, must learn it by bitter experience.

[Editor's Note: So far as the bulk of Mr. Julian's letter is concerned we would say that there is merit in what he says. To the last paragraph, however, we take exception. Thousands of welders are benefiting from the writings of more experienced men than themselves. The welder who is so stupid as to ignore the written warnings of pitfalls ahead of him is hardly worth consideration. Happily this class of welder is in the minority and we meet very few of them. It has been my experience that most welders are not only willing, but anxious to listen to the experience of other welders. The growth of the circulation of *The Welding Engineer* would in itself prove this. 'Tis true that there are stubborn welders who, after reading about what the author considers an improved method, still sticks to old-fashioned methods. This is to be expected. The welding trade is but passing through the same period of transformation through which other trades have passed. So it is up to the more experienced and skillful welders to pass on their experiences, thoughts and theories to their fellows who may not have enjoyed the same opportunities and who are not so skillful.—Mackenzie.]

WELDING IN THE AIR SERVICE IN FRANCE

W. H. Bleecker, Jr.*

In view of Major Pleiss' recent articles in the Welding Engineer on the organizing of the supply of non-toxic gases in the A. E. F., it might be of interest to set forth briefly the amount and character of the welding done by an air service squadron in the field.

It should be borne in mind that any statements in this article apply only to air service squadrons operating in the field, not to the large air service bases where doubtless welding was developed to a very high degree. Therefore, those who are looking for an account of intricate welding jobs successfully accomplished or the details of large scale welding operations will be disappointed in this article, as it is the writer's purpose only to bring out such facts as came within his experience in the 103rd Aero Squadron, the 3rd Pursuit Group and the 2nd Air Park.

The organization of the American air service was originally largely modeled after that of the French. The French permitted only the most minor repairs to planes or motors to be effected within a squadron. Practically every job that could not be handled with a screw driver or a monkey wrench, had to be sent to the rear, and this fact in itself perhaps explains why no official provision was originally made for the use of the welding process by the American squadrons operating against the enemy.

The 103rd Squadron was the first American squadron at the front, being assigned on February 14, 1918, to the French 4th Army, and as such its initial equipment was something to wonder at. Among our Italian trucks, American touring cars and American motorcycles there loomed up a cumbersome machine shop on wheels of French make. This truck must have weighed four tons and was fearfully and wonderfully made, consisting of a 40 horsepower gasoline motor directly connected to a dynamo which in turn drove a motor on the rear axle. Inside there was a small lathe and a small drill press, both electrically driven, a good set of machinist's tools and also—by mistake, probably—a more or less complete oxy-acetylene welding outfit of French make.

Several men in the squadron had had some welding experience and this French set did good work until the single cylinders of oxygen and acetylene which came with the outfit were exhausted. Then a trip to the French parc disclosed the fact that oxygen and acetylene were not to be obtained by the simple process of asking for them. Finally two cylinders of oxygen were obtained, but no acetylene. This was remedied for the time being by using the small cylinders of acetylene supplied with the motorcycles, but these were soon exhausted. Among the jobs successfully attempted were the straightening of bent truck axles, the welding of the truck springs and to some extent the welding of the cast steel water jackets of aeroplane motors.

103rd Aero Squadron.

In April, 1918, the 103rd Squadron was ordered from the 4th to the 8th French Army and was stationed near Dunkirk, on the English Channel, for several months. The acute shortage of oxygen and acetylene was still felt and it was impossible to get any consistent supply of either from the French.

In this vicinity a great deal of trouble was experienced with motorcycles. The roads were for the most part paved with granite block, which, at the speed the motorcycles had to be driven, caused a great deal of breakage of forks and frames. These breaks and cracks would ordinarily have been a simple enough welding job, but, as stated above, it was impossible to obtain gas from the French. However, there happened to be a large shipyard in the city of Dunkirk (Societe des Ateliers et Chantiers de France) which, with a spirit typically French, was operating in spite of the German attempts to wipe Dunkirk off the map by long-range artillery fire and aerial bombardment, and this company readily agreed to attempt the welding. Their willingness, however, was in excess to their ability to do the work successfully, as all the forks which they attempted to weld failed on being put into service again. Examination showed that the metal had been badly burned and that no real weld had been made.

However, it would be dangerous to draw conclusions from the foregoing incident as to the welding practice in French as against American shipyards, since, as previously stated, this yard was operating under extremely adverse circumstances with a very limited force.

In July the 103rd Squadron was recalled from the French

*District Sales Manager Page Steel & Wire Company, Chicago, Illinois.

8th Army and assigned to the Toul sector (the original American sector). On the organization of the American 1st Army it was assigned to the 3rd Pursuit Group along with three other pursuit squadrons.

The story of welding in the 3rd Pursuit Group is a repetition of the experiences of the 103rd squadron already described. Oxygen and acetylene were found to be more readily obtainable through the American supply bases than through the French, but it was impossible to obtain further welding torches from either. It is not surprising that welding torches were not forthcoming since, as stated, they were not yet considered standard equipment, and the bases were already overworked in supplying replacement parts to the ever-increasing number of squadrons at the front, which by this time must have totaled thirty-five or forty.

In August an Air Service order was issued saying that squadrons sending out high patrols (3,000-5,000 meters) were to be provided with oxygen respirators to overcome the physical effects of altitude on the pilots and this order was followed by the arrival of a truck load of 150 small oxygen cylinders and respirators. These cylinders were of about 15 cubic feet capacity and were about 24 inches in length and 6 inches in diameter. However, the pilots on high patrol did not take at all kindly to their use, not more than three or four being drawn out for this purpose. The incident is mentioned merely to show that the American production of oxygen must have been well developed by that time.

Mention has been made previously of the modeling of the American Air Service organization after the French, but by September a radical departure from the French system had been decided on. Instead of sending all broken parts to the rear for repair, it was provided that with each group of squadrons there should be assigned a Park Squadron, whose function it would be to do the supply and salvage work and also the motor overhaul and repair work of the flying squadrons, thus saving the shipping of motors, often as much as 60 or 80 miles, to a base.

The successful operation of such a group of motor repair shop would certainly be attained more readily by the extensive use of welding. When it is considered that in a pursuit group there were 100 planes, 100 trucks, 25 motorcycles and 10 touring cars, the amount of welding jobs that would normally turn up is self evident. In the matter of cracked water jackets alone the saving in time which could have been effected by welding would more than justify its use.

However, it was apparently impossible to obtain further welding sets in spite of repeated requisitions, and so the matter stood at the signing of the armistice.

However, based on the needs of American squadrons in the field, a new air service equipment manual has been issued, and this, the writer understands, provides for the issue as initial equipment of a complete welding set to each flying squadron and three such sets to each park squadron. So much has been gained at any rate.

In closing, the writer wishes to correct any impression that the possibilities of electric welding have been slighted. There is no reason at all why a light, readily portable electric welding set would not be an highly desirable asset to a squadron or a park in the field.

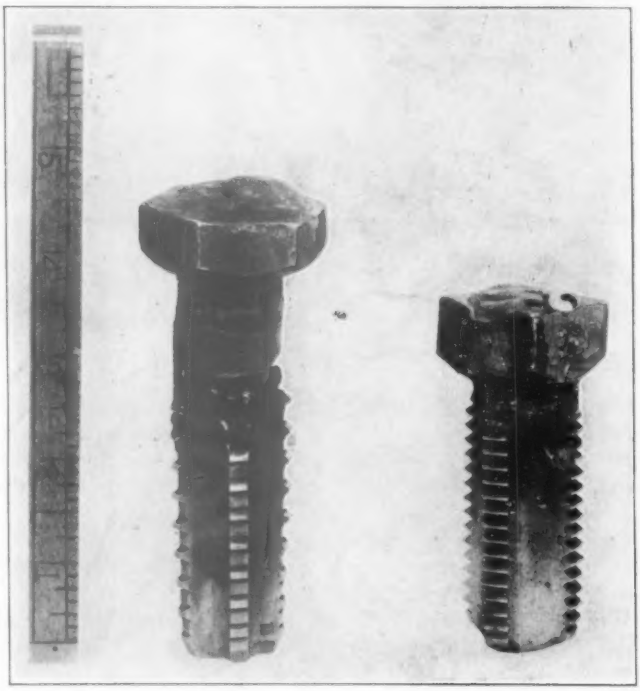
REMOVING BROKEN TAPS

Editor: In the November, 1919, issue of *The Welding Engineer*, I note an item regarding the removal of broken taps by means of the acetylene flame, depending on the expansion of the tap to expand the walls of the hole. This may occasionally work, but one condition to be expected is that the heating would drive the cutting edges of the tap into the walls of the hole with the result that the tap would be the more securely gripped. The temperature to which the tap would have to be heated in order to soften it for drilling would be so high that a considerable mass of the surrounding metal would also have to be heated with the consequent use of considerable gas and time.

I am attaching two photographs, one showing a pile of taps and the other showing two taps only, all having been removed by the electric arc welding process. The first photograph well illustrates the variety and range in size of taps and tap bolts which may be removed by this process. The large tap shown was broken off about ¾ in. down in the hole, as can be seen from the picture, and was removed in about ten minutes. The process is a very simple one and with very little difficulty practically all taps may be removed by any electric arc welder. The procedure is as follows:

Broken Taps Removed by Arc Process.

The arc is struck on the top of the tap and is kept there building up metal until the surface of the casting is reached. An ordinary machine nut is then laid over the hole and the welding continued until the deposited metal builds up inside of the nut, when it is welded fast to the nut. After cooling, the tap is removed by the use of a wrench. Very few cases are found where this procedure fails to remove the tap. Occasionally a tap splinters, as shown in one of the photographs, but even in such a case the weld joins and holds these parts so they all came out properly.



Taps Removed by Arc Process.

The vital point in doing such a job is to keep the arc from striking the side of the hole. Where the arc is kept on the bottom the metal is welded to the bottom and merely runs against the sides, but does not adhere. In some cases a thin sheet of copper or brass is bent to fit inside the hole to protect the threads and prevent welding to the sides of the hole.

General Electric Co.
H. L. Unland, Power & Mining Eng. Dept.

LOCOMOTIVE WELDING

Editor: Am sending you pictures of a job which was done in the Great Northern Shops in this city. It was welding a bridge in between the live steam and exhaust ports of the valve of the high pressure cylinder of a Mallet type engine.

Previous to welding it was fixed (after breaking out) by putting bolts and studs through a brass bridge to hold it tight but every few months they had to fix it over again as it leaked too much.

Figure 1 shows the bridge broken out before welding, it being 20 in. long, 1 in. wide and 3½ in. high, or from where it was broken off to the valve surface.

The first thing we did was to prepare carbons. As we could only build up one inch at a time we used one inch carbon blocks and cut them so we could lay them in without any bother, as it only takes a little longer to make them to fit right.

Next came the furnace. As the fire was needed more on top, we did not run the furnace to the floor but built it up on a platform about two feet high and then the fire was about in the center of the cylinder and higher. We also put a grate (made of wire netting) in the inside of the cylinder and kept a good fire in there. All the bottom and other openings that we could not brick up we closed with sheet asbestos making it as tight as possible to keep the heat in.

Fig. 1. Bridge Broken Out.

Fig. 2. Furnace Ready to Fire.

Fig. 3. Bridge After Welding.

Figure 2 shows the furnace cylinder ready for firing.

It took twenty-three hours to heat it as we did not fire it very strong until the last five hours.

We had the entire cylinder red hot before we started welding and about every hour we stopped and put more charcoal in it to keep it from cooling off.

Figure 3 shows the bridge after welding (marked x) and before machining.

This engine is back in service with but an eight day lay off and as good as new and with a great saving credited to the acetylene welding process of doing things.

B. F. Lange.

YOUR WELDING BUSINESS

By Ed. J. Hardy.

A man's business pays back just what he puts into it, with interest compounded, in proportion to the amount of rightly directed energy, he injects into his work.

The great difference between the welder who fails and the one who succeeds is that one finds the junk pile and converts that junk pile into opportunity, while the other waits for the pile to come to him and even then fails to make the most of it.

The building of a successful welding business calls for more than a mere knowledge of welding. It demands that you apply that knowledge unceasingly, economically and earnestly and that you conduct your shop as a business, in all that the word implies.

Every minute of the day other men are creating opportunities for you, which may be hidden until the need is met as a result of your own initiative.

It depends largely upon the individual effort and the consciousness of this effort as to the rapidity of your growth, however; well directed effort is sure to win whether the evolution is gradual or rapid. Constant attention directed to the smaller propositions will develop a greater capacity for overcoming and mastering the larger and more perplexing problems as they present themselves. A broader perspective is gained through experience and while the logical and judicious course to pursue is sometimes questionable, yet, your ability to analyze and figure out conditions broadens through practice.

Stop and take an inventory of yourself, your business and your methods of conducting it. Ask yourself the questions this self-analysis will suggest. If you have set a mark of attainment, to just what extent have you directed your efforts toward gaining that end?

It is all right to just "rock along," if you are satisfied with what you have and have no fear or anticipation of what the future may have in store for you.

The fact that you are living in a small town where the amount of welding is limited or where competition is keen as a result of an overcrowded field, should not retard your progress.

Did you ever think of the possibilities of a kindred line to work in conjunction with the welding? Every locality has certain demands that are lying dormant waiting for some one to pick them up and develop. A lathe and drill press does not necessitate the outlay of a great deal of capital, and either would be the means of securing a certain amount of profitable business as a side line, and at the same time puts the owner in a position to give better service to his welding patrons. Radiator repairing will often be found advantageous to carry a welder through the dull winter months.

Before you become a welder the chances are, your work was

a line in which welding was a necessary element and as a result of this you became familiar with the oxyacetylene torch and its utility. Look back over your history previous to your becoming a welder and see if there is not something you were making or working at, during that period, which could be turned to an advantage in your business at this time. It may have been something that was manufactured, that you could start in producing, in a small way, but would add materially to your present income in a short time, with the possibilities of developing into something really worth while, later.

The judicious course to pursue is oftentimes hard to determine and you may hesitate to embark in an undertaking which has the element of chance in it. Yet, at the same time, you must remember that there is seldom an instance where anyone embarks in a new undertaking that is not equally beset with some element of chance. That chance, however, is generally governed by your own mental attitude and determination. It is reduced to a minimum where grit is backed up with the proper kind of intelligent application.

Admitting that the power to anticipate the future is more acute in some than in others, your perspective broadens, as stated before, as you become accustomed to consider conditions from a positive viewpoint, rather than a negative. In other words, a man who is everlastingly thinking "I can't" seldom gets to the point of knowing for a certainty, whether he can or can not. In taking the optimistic stand of "I can," he has at least arrived at the point of where he is going to get action and has lifted his mental attitude to the point where results are at least a possibility.

I have read somewhere that it depends a great deal upon the "Metal of a Man," whether the grindstone of life will grind him down or polish him up. This metal of a man is nothing more or less than his mental attitude. It is the mental attitude which largely draws distinction between success and failure.

It is difficult to make the acid test of opportunity in advance because of the elements that must be taken into consideration and yet when you stop to consider that this is an age of manufacture, a time when the demand for almost everything in commercial use is greater than the supply, the law of average in your favor far outbalances the element of chance.

It is you and no other, that must take the initiative in deciding what you will do—do it!

You have, no doubt, at some time wondered how a certain person has made such a success of his business, when you and every one else felt the man had never been endowed with his full quota of gray matter. Were you to make an analysis of his business methods, you would undoubtedly find that the predominating elements in his success were his careful attention to details and initiative, backed up with the determination "to do." The last two words explaining the successful carrying out of the first two essentials.

It was the mental attitude of the man that assured the success of his undertaking. It was the mental attitude of the "Doughboy" in going over the top, that determined his successful rout of the Hun and the breaking of the Hindenburg Line. It is mental attitude that supplies the motive power to intelligent action, and it is your mental attitude that keeps you digging when discouragement and pitfalls beset you on all sides. It eliminates discouragement and bolsters up effort. It is the birthright of all.

If you have not the capital that you can put into your business you can inject that element without which capital avails you nothing. The only conclusive evidence of your sincerity is that you inject into your business that element which is sincerity—you must be willing to pay the highest price of success—the price which success exacts. The determination "to do," is sincerity—to be maintained at all times and under all conditions. Sincerity demands eternal vigilance and earnestly directed effort. It is a most valuable asset to both business and character but sincerity is no slacker and will not tolerate one.

Regardless of the direction in which a man may exert his efforts, you will find that the more sincere he becomes in his work, in just that proportion will he reap the reward of his sincerity. It is a virtue that develops through earnest endeavor and while at first it may demand will-power to maintain, we soon become so accustomed to being sincere that no conscious effort is necessary to keep ourselves keyed up to the point of where we are hitting on all six cylinders.

One might say that sincerity is the spark plug that keeps the human engine popping and believe me, spark plugs have to be kept clean to allow energy to exert itself.

LOCOMOTIVE CYLINDER

Editor: Enclosed please find picture of cylinder welded at Pocatello, Idaho, on the Oregon Short Line.

This is a high pressure cylinder on a Mallet type engine, and had the top half of the flange broken out, it was a clean break and did not require any chipping at all. Carbon blocks were cut to fit and brick wall built around the cylinder and filled in with charcoal. A two-inch space between the brick wall and cylinder makes a good furnace.

The fire was started in the furnace at eight o'clock in the morning and two hours later welding was started using two

Welded Cylinder.

Oxweld torches, one on each side, working up towards the center until the flange was filled up, then one torch was used to finish the job which was completed at eight o'clock that evening. Four welders were required on this job on account of the intense heat, two welders resting while the other two worked in turn.

One hundred and fifty-two pounds of cast iron rods were required to complete this job, which was done by C. E. Allen, District Superintendent of the Oxweld Railroad Service Company, Geo. Hauskins and Walter Fortmeyer, both instructors with the Oxweld Company and Arthur Thiel, welder for the Oregon Short Line Railway.

As this may be of interest to the welding trade, I will be glad to see it published in your next issue.

WALTER FORTMEYER.

ARC WELDING APPARATUS *and* ITS APPLICATIONS

A. M. Candy*

Although the use of the electric arc for depositing molten binding or filler metal has been known for over thirty years, the recent work of the Emergency Fleet Corporation's welding committee has awakened the industrial world to a realization of the very great economic value of the various electric welding processes. This paper, however, will be confined to the specific subject of electric arc welding.

Briefly, we may define arc welding as the utilization of the intense concentrated heat of the arc for fusing metals so they will commingle and be united when solidified. The electric arc is inherently an unstable electric circuit operating at a potential far below that of commercial transmission systems. It is always necessary, therefore, to install satisfactory electrical apparatus which ill provide the proper characteristics for the yielding current.

D. C. Arc Welding

Until quite recently only direct current has been used for arc welding service, therefore we will discuss D. C. apparatus before considering alternating current equipment. For this service there are two general types of equipment available known as single operator and multiple operator outfits. The single operator equipment comprises a ball bearing motor generator set (See Fig. O.) and control apparatus which can be mounted on a small roller bearing industrial truck for portable service as illustrated by Fig. 1.

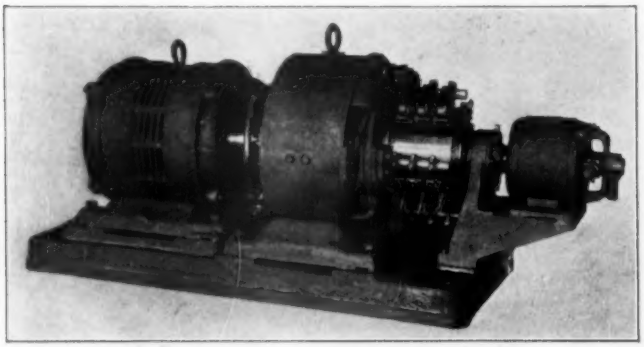


Fig. 0.

The motor for the set can be provided for any of the usual commercial transmission circuits, of either direct or alternating current of such customary potentials as 550-440-230 volts. The generator, however, is one of the latest and most efficient designs for arc welding service. This machine, due to its unique design and construction, is unusually satisfactory for supplying power direct to a welding arc without the use of any stabilizing resistance or reactance in the circuit. The unique volt—ampere characteristic of this generator is illustrated by Fig No. 2 which indicates the characteristics when operated at three different current values; namely, 110, 150 and 190 amperes. The generator is actually capable of operation over a range of 80 to 200 amperes, the various current values being obtained by simply adjusting the field rheostat in the separately excited field circuit. The exciter shown on Fig. 1, provides the separate excitation. Fig. No. 4 is an exact reproduction of an oscillographic record showing the arc voltage and current characteristic in actual welding service.

*Gen. Eng. Dept. W. E. & M. Co., Pittsburgh, Pa.

As the name single-operator implies it is only possible for one operator to use this type of a generator at a given time. The chief field for such equipment therefore is where there is only sufficient work for one welder or where the work is scattered over considerable territory. In the latter instance the installation of several single operator ets either stationary or portable will reduce investment charges due to eliminating long circuits of heavy copper.

Multiple operator equipments, comprise motor generator-sets having sufficient capacity to supply current to several welding circuits at one time. Fig. No. 5 is a typical 1000 ampere A. C. to D. C. set and Fig. No. 6 is a 300 ampere D. C. to D. C. set. The generator of these outfits is a standard compound wound commutating pole type developing a potential of 60 volts. To control the generator a standard generator control panel can be used or a standard combination generator control and welding control panel may be supplied. A front view of the latter type of panel is indicated by the left-hand panel of Fig. No. 7. The wiring diagram of this panel including the control or ballast resistance is indicated by Fig. 8. The two pole switch at the left controls the welding circuit for the panel, whereas the two pole switch at the right is a feeder switch for a bus line to which one or more welding circuit or outlet panels may be connected. Such an outlet panel is illustrated at the right of Fig. No. 7 and the scheme of connections by Fig. No. 9. The resistance connected to the single pole switches and in series with the electrode holder serves two purposes namely, (1) stabilizing the arc and, (2) providing a means for varying the current. It is obvious that when the single pole switches are closed a number of parallel pats are provided so that an increased current is available.

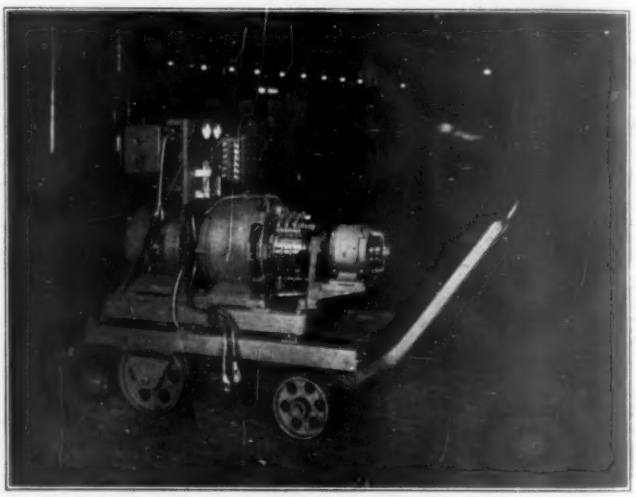


Fig. 1.

For welding circuit deriving power from a constant potential circuit of 60 volts or lower we find it desirable to employ a small reactor in addition to the resistance when the metal electrode is used. The reactor greatly minimizes the tendency for the electrode to fuse to the work which is commonly known as "freezing." The action is briefly as

follows: With a 60 volt line and a 20 volt arc we have about 40 volts across the resistance which allows a certain current to flow for welding. However, when the operator touches the electrode to the work to strike the arc there is very little voltage drop between the electrode and the work,

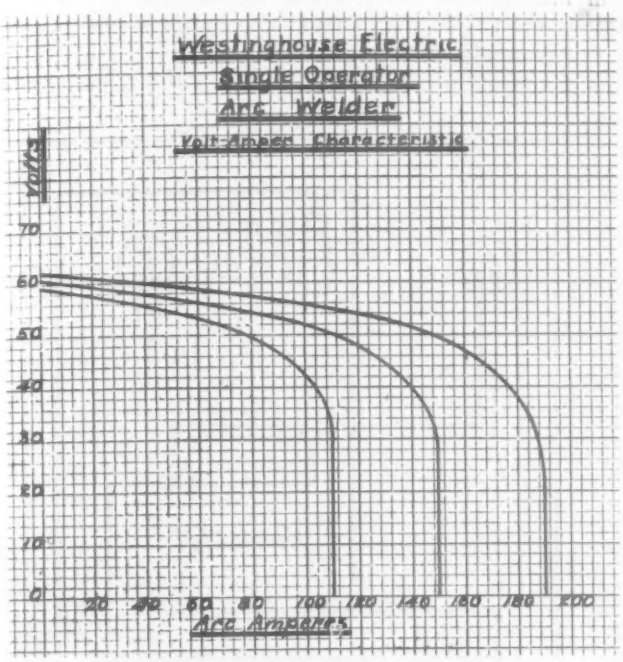


Fig. 2.

therefore, at that time the voltage across the resistance will be increased from 40 volts to possibly 58 volts. As a result the current flowing will be about 45 per cent higher than the welding current. Therefore if the electrode is left in contact with the work even only momentarily it becomes fused and sticks. When the operator pulls the electrode away from the work the reaction frequently results in moving the electrode so far that the arc is broken. As a result the operator will frequently strike his arc two or three times before finally holding the arc. This phenomenon is strikingly illustrated by Fig. No. 10. Now, if a small reactor as illustrated by Fig. No. 11 is connected in the circuit it will choke or throttle the current so that it will not build up to the maximum value so rapidly and therefore the operator can establish his arc before the electrode sticks as indicated by Fig. No. 12.

There are some applications where the weight of a portable single operator set (1150 lbs.) makes it somewhat undesirable. For such installations a small portable outlet panel entirely self-contained can be used where a 60 volt circuit of sufficient capacity is available. Such a panel is illustrated by Fig. 13, the net weight of the panel being about 250 pounds. The scheme of connections and the current values obtainable are indicated by Fig. No. 14.

A. C. Arc Welding

When attempting to develop apparatus for alternating current arc welding we find that the problem is in some

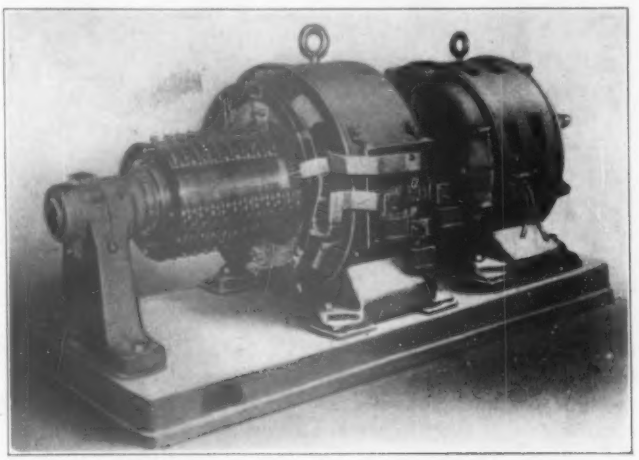


Fig. 5.

respects more difficult of solution than in the case of direct current. This is due to the fact that the A. C. arc is not nearly so tenacious as the D. C. arc. In other words, every instant when the alternating current passes through the zero value there is a marked tendency for the arc to break. In fact if the current through the arc and the voltage across the arc are in phase so that both pass through the zero value at the same time it is impossible to maintain a welding arc either with the carbon electrode or a bare metal electrode. Covered metal electrodes, however, can be operated under these conditions at current values of 100 amperes and above providing the potential of the supply circuit is at least 100 to 110 volts.

To enable an operator to maintain an alternating current arc, easily, with a bare metal electrode, the apparatus must provide three functions; first a constant rate of fusion of

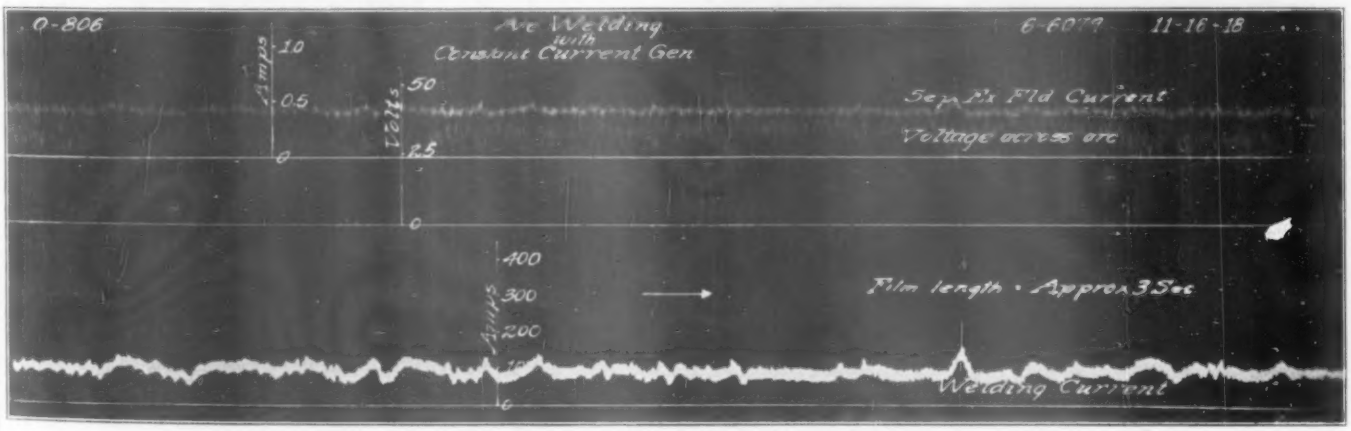


Fig. 4.

the electrode; second proper phase relation between current and voltage; third the correct operating voltage.

To fulfill the above requirements we have found that the well known constant current arc lighting type of transformer of sufficient capacity is satisfactory. With all conditions as required we find, however, that the power factor

of the welding circuit is about 20 per cent, and the efficiency will be about 80 per cent. On this basis if 175 amperes is used for welding the power taken from the line will be 4.4 K. W. or 22 K. V. A., whereas, the single operator direct current set described herein before will take from

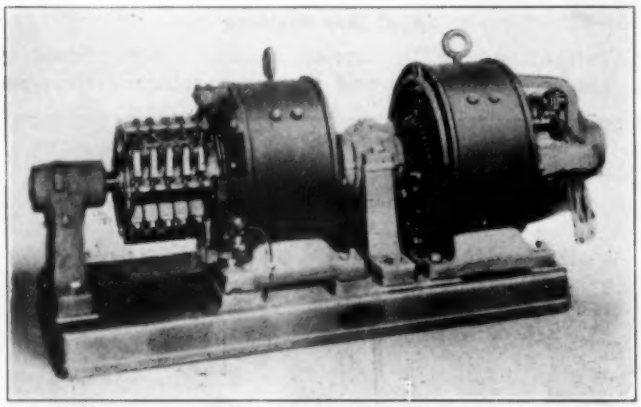


Fig. 6.

the line 7.1 K. W. or 8.25 K. V. A. A transformer of a capacity comparable with the single operator set will have a weight of approximately 450 pounds, whereas the single operator equipment will weight about 900 pounds total.

In all arc welding work the operator must be protected against the light radiating from the arc. To protect the head and eyes several devices are available such as the

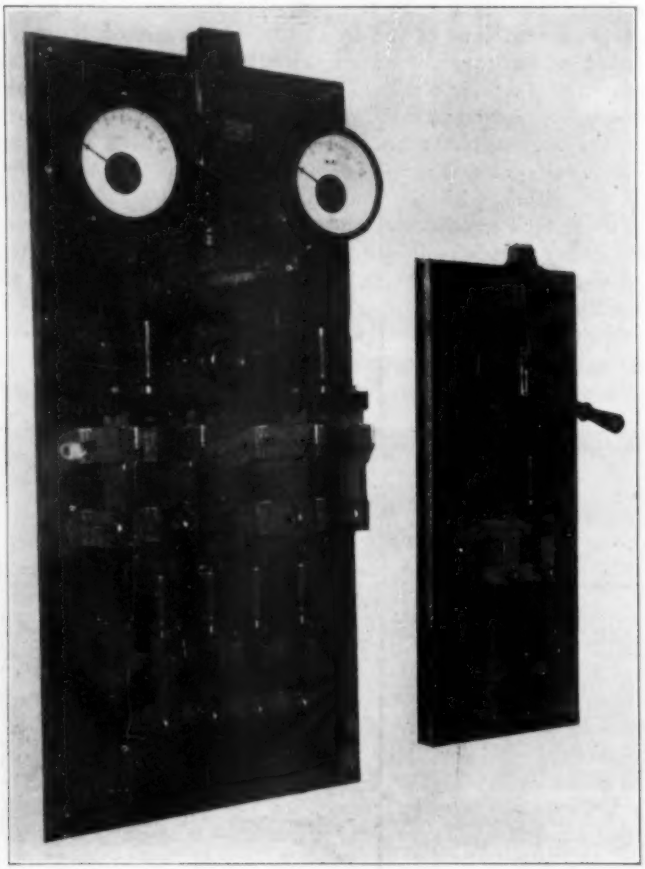
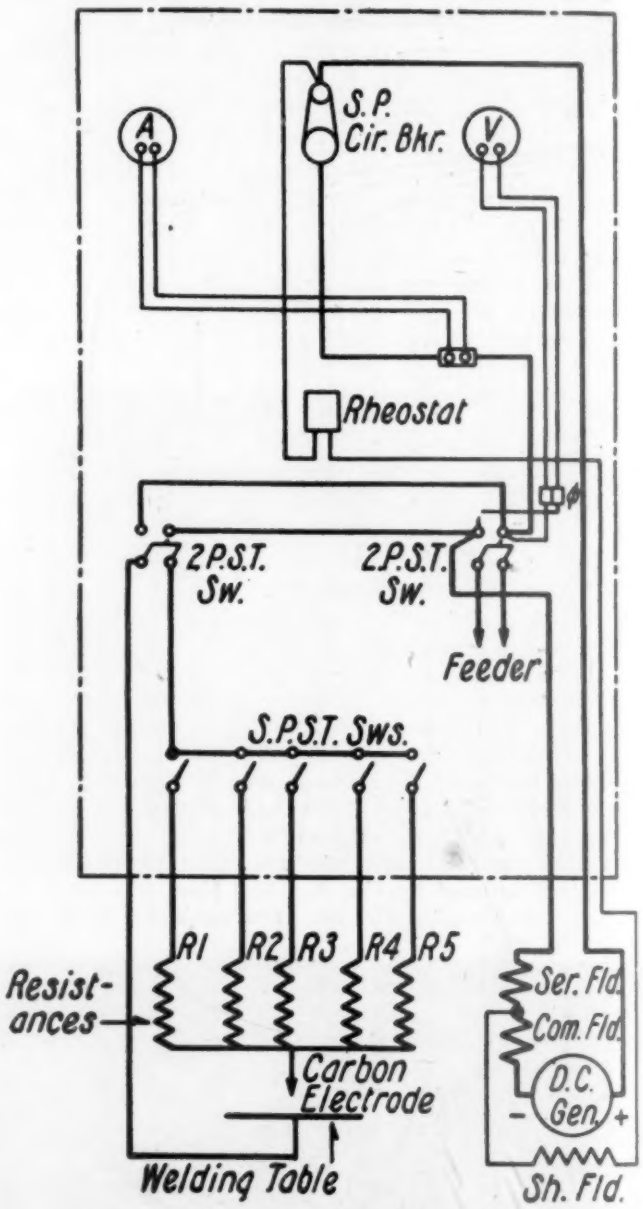


Fig. 7.

hood or helmet at the center of Fig. No. 15, the shield at the right, and the mask at the left.

To enable the operator to manipulate the electrodes two forms of electrode holders are available as illustrated by Fig. No. 17. The lower one is the carbon or graphite electrode holder whereas the upper one is the metal electrode holder. To provide greater flexibility to reduce the weight on the operator's arm the cable usually attached to the holder is considerably smaller, for the current carried than used for general transmission work, as a result the cable will become appreciably heated in service. To prevent this heat from making the holder handle uncomfortably warm, the cable is not passed through the grip but is shunted directly to the electrode gripping member.

As mentioned previously in this paper, the applicability of



Right-Schematic diagram class I combination control panel.

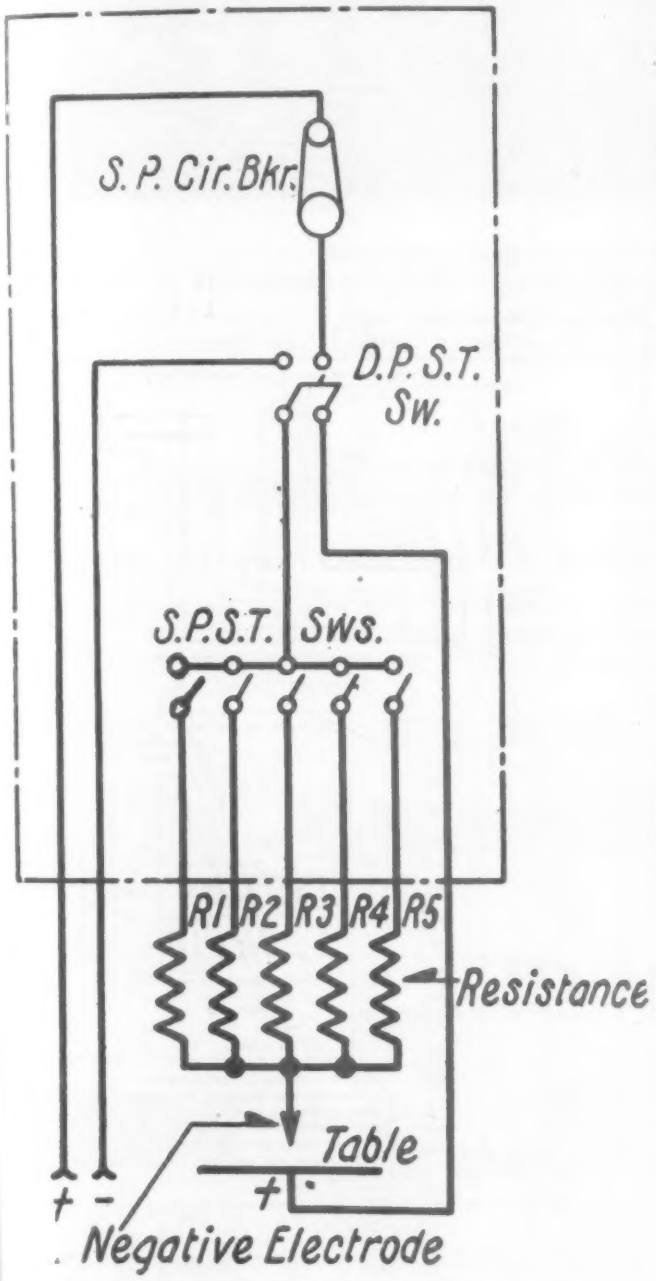
Fig. 8.

the electric arc for welding purposes has been known for many years and yet only within the last four or five years has any extensive use been made of the processes. Probably the chief reasons for the apathy of the industrial world have been the lack of general information as to the proper methods of procedure and application and the promiscuous haphazard application, accompanied by lack of proper supervision and inspection of the work. This status, however, is being rapidly improved by the publication of data ob-

tained by experimental and research work carried on by a number of manufacturing companies and other organizations.

General Welding Principles

To produce satisfactory arc welds regardless of the particular metal welded there are six fundamental principles, which must be observed systematically.



Left-Schematic diagram of outlet panel.

Fig. 9.

(1) Proper preparation of material prior to welding.
(2) Selection of electrode material having best suited physical, chemical and electrical characteristics.
(3) Use of proper volume of current.
(4) Maintenance of short arc with the metallic electrode.
(5) Proper sequence of tacking and filling.
(6) Heat treatment subsequent to welding.

Preparation of Work

Material to be welded must always be given a thorough preliminary cleaning to remove foreign substances such as grease, oil, sand and heavy crusts of oxide or rust. For this service the sand blast, metal wire brushes and air chisels are recommended. In addition the edges of the parts to be welded must be mechanically shaped to provide ready access for the welding electrode and filler material. The edges of all plates ⅛ inch or more in thickness must be beveled so that a total angle of 90 degrees is available in which to deposit new metal. This angle cannot always be obtained but the angle should never be less than 60 degrees. Furthermore, the closest edges at the apex of the angle must be spaced ⅛ inch to 3-16 inch apart if at all possible, as indicated by Fig. 18. When a crack in a casting is to be repaired it is usually best to drill a hole through the casting just beyond the end of the crack to keep it from extending when the heat is applied. The edges of the crack must be beveled off as explained for plate material. This may be done mechanically by chiseling or the carbon electrode arc may be used to melt the edges to the proper shape.

The importance of a sufficiently wide bevel angle and spacing between plates is illustrated by Fig. 19 and Fig. 20. The piece at left of Fig. 19 was scarfed at an angle of 30

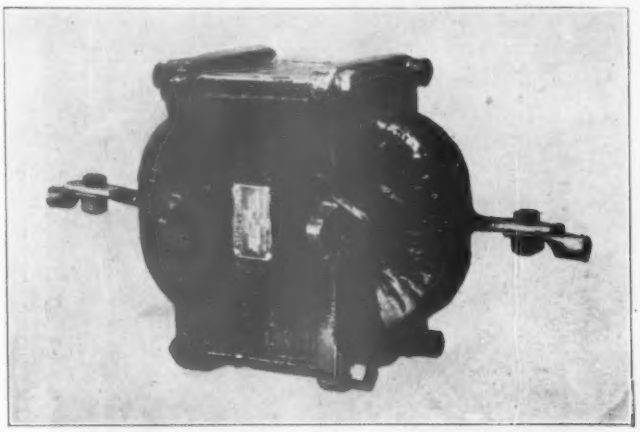


Fig. 11.

degrees and was placed adjacent to a similar piece with no space between the lower edges. This formed a total angle of 60 degrees which was too narrow to permit good fusion so that the molten metal merely ran down into the groove. The piece at the right was spaced ⅛ inch from the plate to which it was welded. By careful operation the operator was able to secure good fusion even though the angle was only 60 degrees. Fig. No. 20 shows a weld made where the total angle was 90 degrees and the pieces were spaced ⅛ inch apart. This is the best practice.

Selection of Electrodes

Generally speaking the use of metallic electrodes has proven more satisfactory than the use of the carbon electrode. This is due principally to the fact that the metallic electrode process is automatically productive of good fusion. In other words, the arc which melts the end of the electrode conducts the metal directly to the molten puddle on the work. In the case of the carbon electrode it is possible for the operator to melt the filler material more rapidly than the molten puddle is formed on the work, therefore the molten filler overflows cold parts of the work thereby failing to produce fusion or a union at these places. In the hands of an experienced and careful welder, equally good results can be obtained by the carbon process. This is illustrated by Fig. No. 21. Probably the chief field of usefulness for the carbon electrode is that of cutting, or for rapid

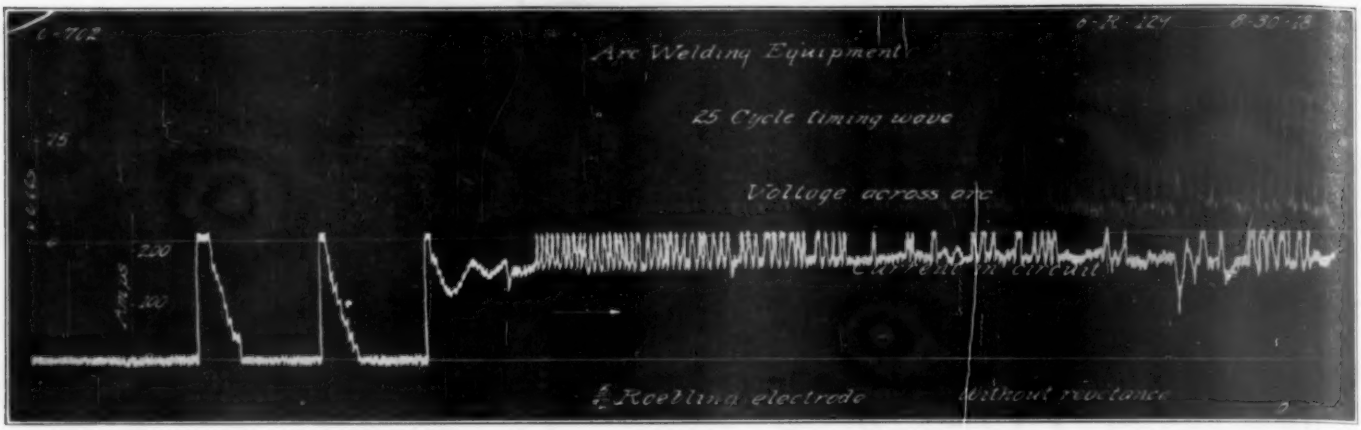


Fig. 10.

repair welding where strength is secondary to speed of production. Small carbon electrodes, however, have been used successfully for tank construction using thin sheet metal

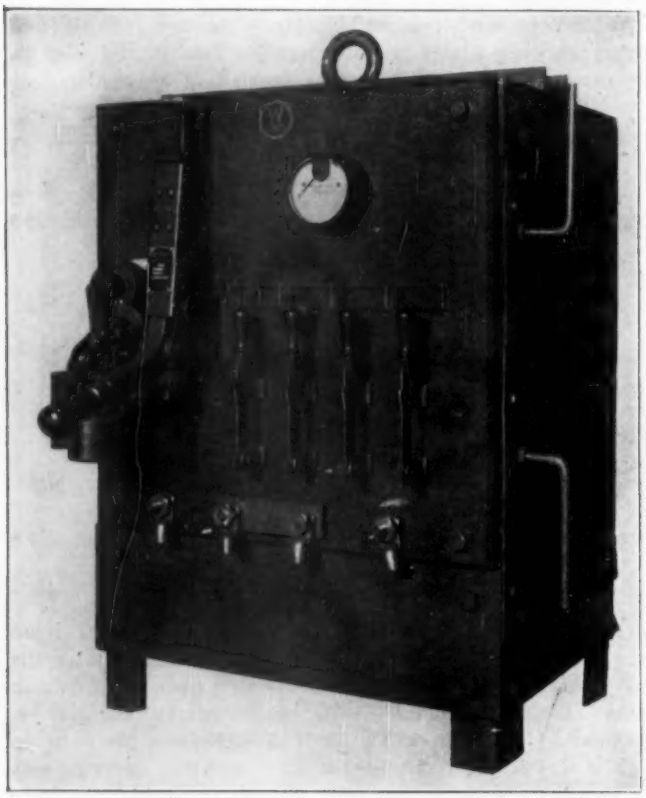
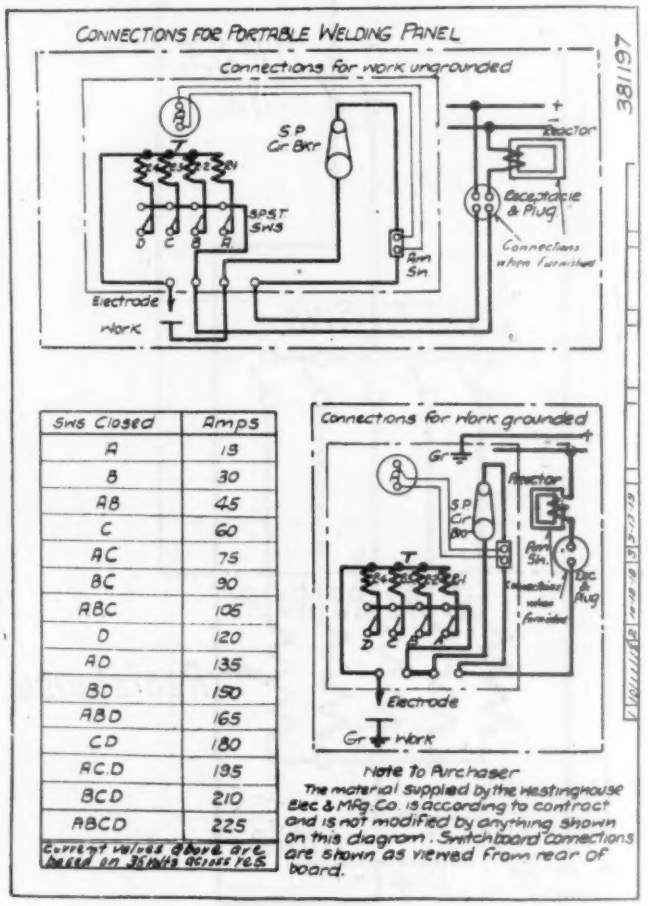


Fig. 13.

where the edges of the sheets can be melted to form the weld no filler being used.

For metallic electrode welding of steel and cast iron the electrode must be of a uniform homogenius structure, free from oxides gases pipes seems etc. and should be of the quality and finish known as "Bright Hard" or "Bright Soft



SWS Closed	Amps
A	15
B	30
AB	45
C	60
AC	75
BC	90
ABC	105
D	120
AD	135
BD	150
ABD	165
CD	180
ACD	195
BCD	210
ABCD	225

Current values given are based on 35 volts across arc.

Fig. 14.

Finish." The chemical composition to be as follows:

Carbon, not over 0.18%

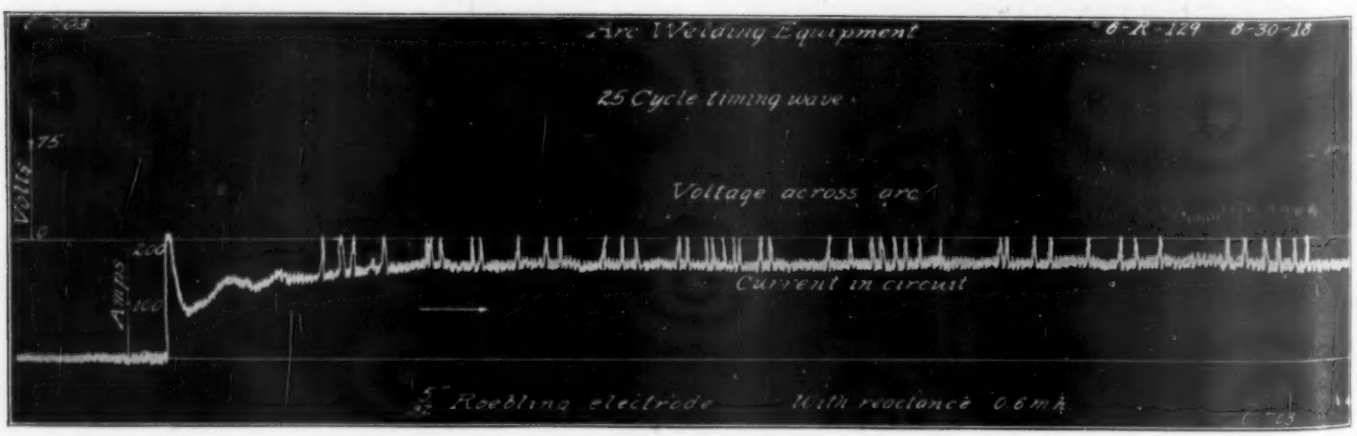


Fig. 12. ...

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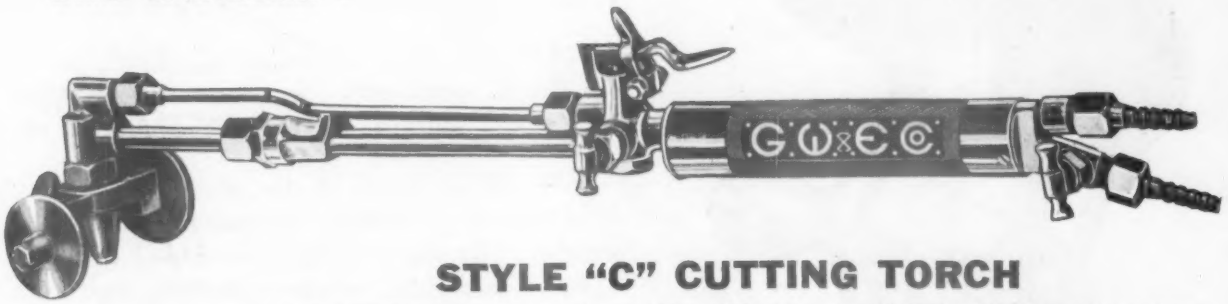

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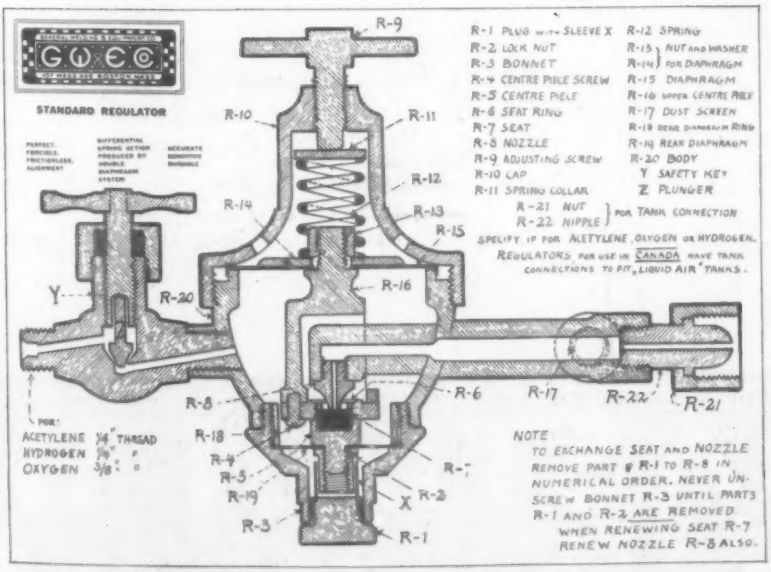
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R-2 LOCK NUT
R-3 BONNET
R-4 CENTRE PIECE SCREW
R-5 CENTRE PIECE
R-6 SEAT RING
R-7 SEAT
R-8 NOZZLE
R-9 ADJUSTING SCREW
R-10 CAP
R-11 SPRING COLLAR
R-12 SPRING
R-13 } NUT and WASHER
R-14 } FOR DIAPHRAGM
R-15 DIAPHRAGM
R-16 UPPER CENTRE PIECE
R-17 DUST SCREEN
R-18 REAR DIAPHRAGM RING
R-19 REAR DIAPHRAGM
R-20 BODY
Y SAFETY KEY
Z PLUNGER
R-21 NUT
R-22 NIPPLE
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REGULATORS FOR USE IN CANADA HAVE TANK CONNECTIONS TO FIT "LIQUID AIR" TANKS.
FOR:
ACETYLENE 1/4" THREAD
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NOTE
TO EXCHANGE SEAT AND NOZZLE REMOVE PART # R-1 TO R-8 IN NUMERICAL ORDER. NEVER UNSCREW BONNET R-3 UNTIL PARTS R-1 AND R-2 ARE REMOVED WHEN RENEWING SEAT R-7 RENEW NOZZLE R-8 ALSO.

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The centre of gravity is close to the cylinder, reducing to a minimum the hazard of damage, frequent with regulators with long inlet arms.

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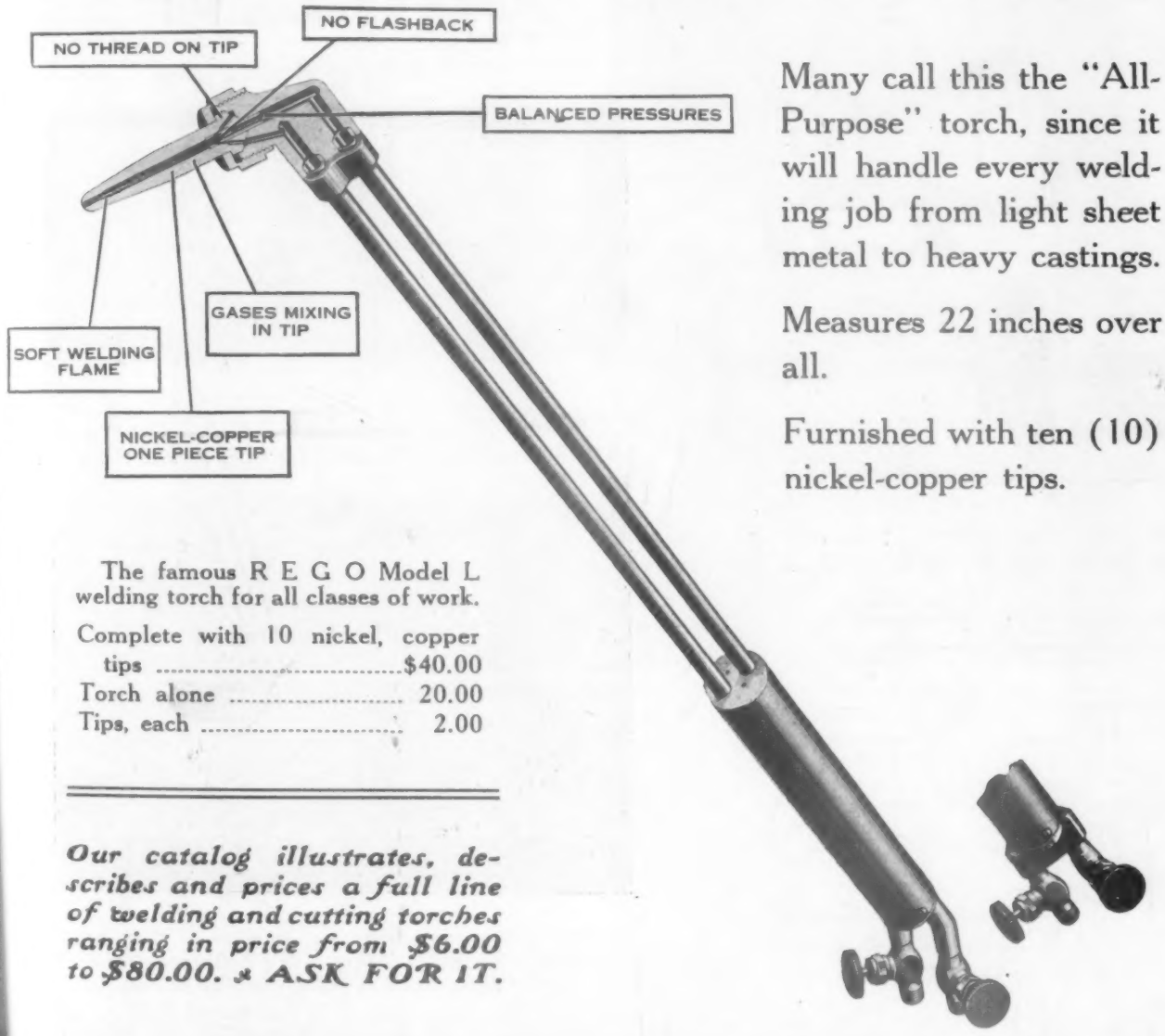

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The famous R E G O Model L welding torch for all classes of work.

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Torch alone	20.00
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Manganese, not over 0.55%
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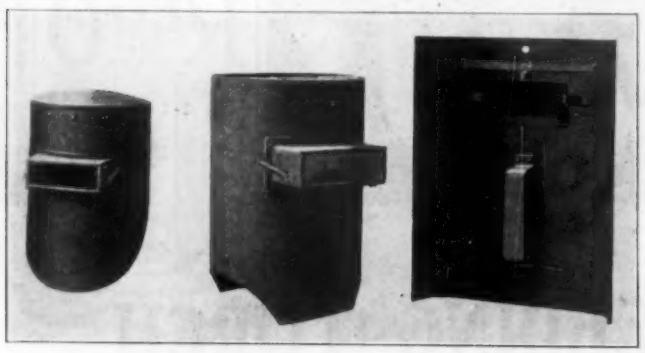


Fig. 15.

Sulphur, not over 0.05%
Silicon, not over 0.08%

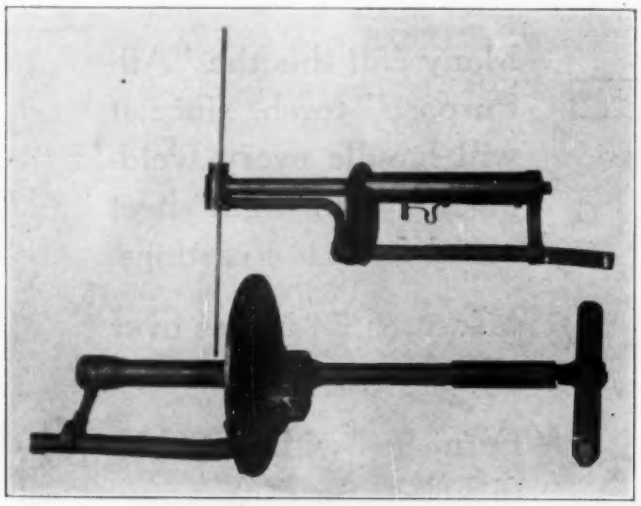


Fig. 17.

The proper chemical composition of the electrode material does not necessarily determine its suitability for weld-

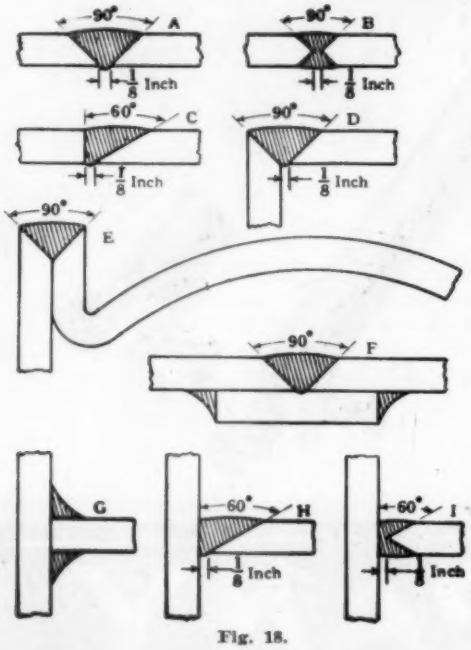


Fig. 18.

ing. This is illustrated by Fig. No. 22, which curve was obtained when a hot rolled steel electrode was used, the analysis of which is:

Carbon .....0.13 to 0.17%
Manganese 0.50%

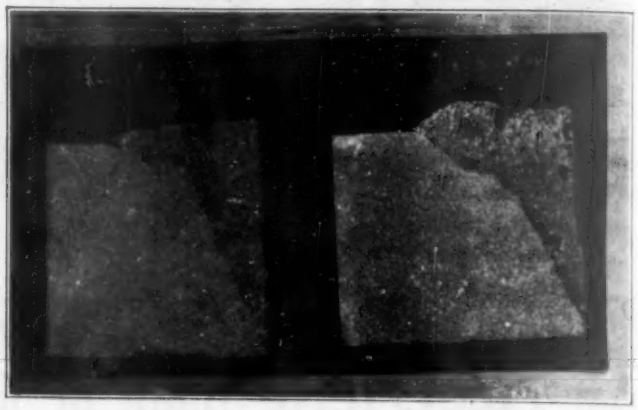


Fig. 19.

Fig. 20.

Phosphorous 0.012%
Sulphur 0.045%

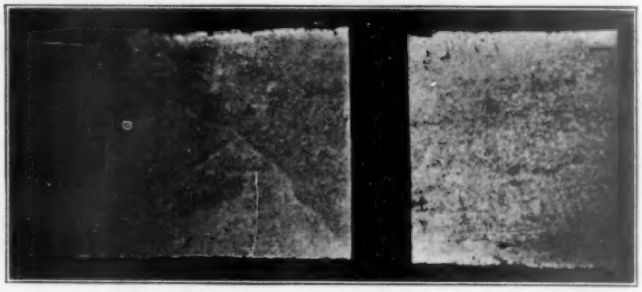


Fig. 21.

Silicon 0.011%

This electrode, probably due to greater surface tension of

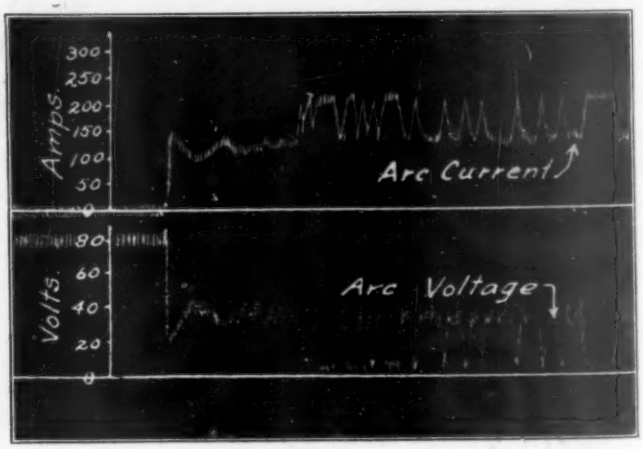


Fig. 22.

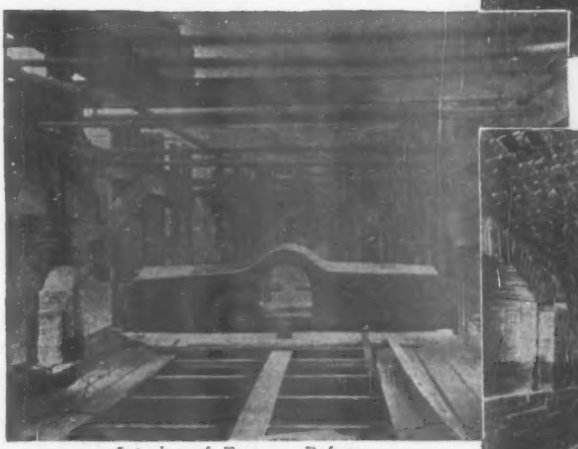
the molten metal, had a tendency to pass through the arc in comparatively large globudes which partially shorted the arc, resulting in the current peaks. It was quite difficult to weld with this wire. Some operators have found that bare wire which does not work satisfactorily can be dipped in white wash and can then be used.

(To be continued in the February issue.)

The subject of welding manganese frogs and crossings is an interesting one, about which the welding trade at large knows very little. Those of our readers who have had experience along these lines are urged to tell us about their experiences.

ARMCO IRON WELDING RODS

General View of Ports



Interior of Furnace Before Laying Brick

Interior of Furnace After Laying Brick

Water-cooled Ports for Open Hearth Furnaces Welded with Armco Iron Welding Rods

The water-cooled ports illustrated were manufactured by Blaw-Knox Company, Pittsburgh, for the American Rolling Mill Company, Middletown, O. The ports mounted in furnaces as shown are subjected to a temperature of 3000° F. on one side and the temperature of water at approximatly 60° F. on the other. All welds made with ARMCO IRON Welding Rods.

ARMCO IRON Welding Rods are furnished for both electric arc welding and oxy-acetylene welding. They are the purest commercial iron in the world—99.84 per cent pure iron content (minimum) guaranteed. They flow freely, weld evenly and lend themselves perfectly to finishing operations. Ask our nearest branch office for addresses of ARMCO distributors in your locality.

PAGE STEEL & WIRE CO.

Established 1883 as Page Woven Wire Fence Co.

Makers of ARMCO IRON Welding Rods and Electrical Wire; "Copperweld" Copper Clad Steel Wire; Wire Mill Products, Plain and Galvanized; Wire of Special Analysis; Wire Fencing for all Purposes; Factory Gates; Ornamental Iron Fences; Machine Guards; Tool and Stock Room Partitions; Architectural Iron.

PLANTS: Monessen, Pa., and Adrian, Mich.

Sales Offices: 30 Church Street, New York

CHICAGO, 29 South LaSalle St. **DETROIT, Book Building**

San Francisco: American Rolling Mill Company of California

Canadian Distributors: Taylor & Arnold, Ltd., Montreal, Toronto, Winnipeg (65)

Who's Who

Charles L. Bastian

Charles L. Bastian, the president of The Bastian-Blessing Company, manufacturers of Rego welding and cutting apparatus, was born in Germany in 1861. When nineteen years old he came to this country and until 1885 worked upon a farm. At this time he took an intensive course in bookkeeping and language, and in 1886 became connected with the T. S. Wild Manufacturing Company as bookkeeper and secretary of the company. It was during his connection with this company

Charles L. Bastian.

that he discovered his aptitude for mechanical appliances, and he took evening courses in mechanical drawing. A short while later he purchased an interest in this company, and in 1891 organized the Charles L. Bastian Manufacturing Company.

It was at this time that he designed his first cylinder valve which was exhibited at the World's Fair in Chicago in 1893.

In 1903 the Charles L. Bastian Manufacturing Company was absorbed by another company, Mr. Bastian becoming superintendent. It was at this stage of his career that he invented and developed a large number of mechanical appliances for high pressure gases, among them the diaphragm regulator in such common use today on all high pressure gases.

In 1907, because of nervousness and overwork, Mr. Bastian lost his eyesight. His vision was completely gone and he has never regained it.

At this time in his life, it would naturally be assumed that he would retire. He was forty-six years old, and apparently was valuable because of his sight, since he was inventing and designing mechanical apparatus where vision would seem to be essential.

In spite of the handicap of blindness in 1908 he, together with men still associated with him, organized and became president of the Bastian-Blessing Company, then a comparatively small corporation of $50,000 capital.

In the early days of the oxy-acetylene welding industry in this country, Mr. Bastian was quick to realize the possibilities of the process, and designed regulators suitable for oxygen, hydrogen and acetylene. The growth of the regulator department of The Bastian-Blessing Company has been remarkable.

Mr. Bastian has a large number of patents on regulators, cylinder valves, etc., besides having designed a great deal of automatic machinery for gas purposes other than that used in the welding industry.

He is a very active man, coming to business daily, and keeping in close touch with every department of the company. His memory is remarkable, and it is amazing to those only slightly acquainted with him for them to realize his grasp on all mechanical subjects. He is constantly designing and improving mechanical equipment manufactured by his company, and everything manufactured by The Bastian-Blessing Company is examined and approved by him before being put into production.

Although unable to get out and meet the trade, he has a very large acquaintance in the welding and cutting industry because very few engineers come to Chicago without calling upon him and talking over conditions.

The Bastian-Blessing Company is now a highly prosperous institution, operating two large manufacturing plants, one in Chicago and the other in Grand Haven, Michigan.

The success of this man should be an inspiration to readers of *The Welding Engineer,* who believe they are handicapped. Mr. Bastian's success in life came after he was forty-six years old, and blind.

PROTECTING THE EYES OF WELDERS

During the process of oxy-acetylene welding, it is found desirable, or sometimes absolutely necessary, that the eyes of the workman should be protected from the glare of the flame. The continual use of goggles is often found to be very tiring. In many cases of acetylene welding where the work is small and occupies a fairly constant position in relation to the blowpipe flame and to the operator, the inventors have found that a screen of colored glass or the like amply protects the eyes of the operator, and is much less tiring and more effective than the perpetual wearing of goggles by the operator.

The present invention, by Petters, Ltd., and R. G. Dellow, both of Yeovil, relates to a screen of suitable colored glass or the like interposed between the acetylene blowpipe and the operator. The invention also comprises a protective screen which can be quickly attached to and detached from an acetylene blowpipe. The invention also consists in means for adjusting the position of the screen in relation to the tube of the blowpipe on which the screen is supported.

The accompanying drawings illustrate the carrying into effect the invention in one form. Fig. 1 is a perspective view of the blowpipe in relation to the work being operated on together with the screen fastened to the blowpipe. Fig. 2 is an elevation of the screen and stand. Fig. 3 is a sectional elevation of the screen and stand. Figs. 4 and 5 show a modi-

Oxygen In War

Writing in "The Welding Engineer," Major Paul Pleiss of the U. S. Army Air Service describes the extensive use of oxygen in keeping the war machinery in repair during the great struggle. It was found in use that **oxygen made by the electrolytic process** was from 2% to 5% purer than other oxygen. A 2% increase in purity means at least 25% increased efficiency.

Get Purest Electrolytic Oxygen

From These Companies:

CALIFORNIA
California Burdett Oxygen Co., Los Angeles
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COLORADO
Burdett Oxygen Co., Denver

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Burdett Oxygen & Hydrogen Co., Chicago
Electrox Co., Peoria
Swift & Co., Chicago

INDIANA
Indiana Oxygen Co., Indianapolis
Logansport Oxygen Co., Logansport

IOWA
Bettendorf Oxygen Hydrogen Co., Bettendorf

KENTUCKY
Kentucky Oxygen & Hydrogen Co., Louisville

MICHIGAN
Michigan Ox-Hydric Co., Muskegon
National Oxygen Co., Detroit
Burdett Oxygen Co. of Detroit, Detroit

MINNESOTA
Commercial Gas Co., Minneapolis

MISSOURI
Oxygen Gas Co., Kansas City (two plants in Kansas City)
St. Louis Oxygen Co., St. Louis

MONTANA
Mountaineer Welders Supply Co., Butte

NEBRASKA
The Balbach Company, Omaha

NEW YORK
Standard Oxygen Co., New York City
International Oxygen Co., College Point, L. I.

NEW JERSEY
International Oxygen Co., Newark
Standard Oxygen Co., Hoboken

OHIO
Burdett Oxygen Co. of Cleveland, Cleveland
Ohio Chemical & Mfg. Co., Cleveland
Ohio Electrolytic Oxygen Co., Cincinnati
Clarke Chemical Co., Wickliffe

OKLAHOMA
Burdett Oxygen Co. of Oklahoma, Oklahoma City

OREGON
Portland Oxygen & Hydrogen Co., Portland

PENNSYLVANIA
International Oxygen Co., Verona
Burdett Oxygen Co., Philadelphia (Plants at Chester & Norristown)
Burdett Oxygen & Hydrogen Co., Pittsburgh
National Oxygen Co., Erie

TENNESSEE
Burdett Oxygen Co., Chattanooga

TEXAS
Burdett Oxygen Co. of Texas, Ft. Worth
Magnolia Gas Products Co., Houston

UTAH
Whitmore Oxygen Co., Salt Lake City
Utah Burdett Oxygen Co., Salt Lake City

WASHINGTON
Washington Burdett Oxygen Co., Seattle

WISCONSIN
Universal Oxygen Co., Sheboygan

BRITISH COLUMBIA
Compressed Gas Co., Ltd., Vancouver

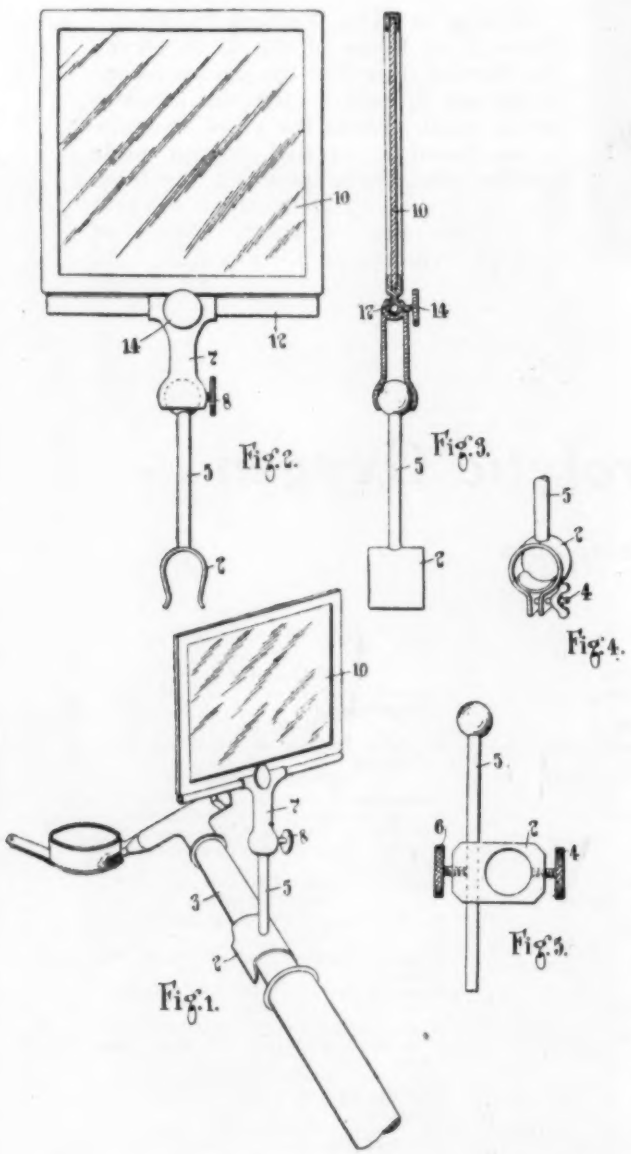
GAS PRODUCTS ASSOCIATION

801 Marquette Bldg., Chicago, Ill.

fication of the clip used for clamping the screen and stand to the blowpipe.

A base piece 2, Fig. 5, adapted so as to be quickly attached or clamped to the blowpipe may be provided, and a single clamping screw 4 may be used for this purpose. Or, as shown in Fig. 1, the base piece may be made as a spring clip or clips which can be sprung over the blowpipe with sufficient resilient pressure as to retain the base piece in whatever position it is set in relation to the blowpipe.

The base piece may be drilled through to receive a round supporting rod 5 which can pass through the drilled hole or turn therein and a clamping screw 6 in the base piece may be used to fasten it in any desired position. In Figs. 1, 2 and 3 a simpler form is shown, the supporting rod being fastened integrally to the base piece. A frame holder 7 is jointed at the top end of the supporting rod, and a clamping screw 8 is used to fasten them in the desired position. The joint shown in Figs. 1 to 3 is a ball and socket one, the ball being fastened to the end of the supporting rod, and the socket being formed on the stem of the holder 7. The screen 10 of colored glass is carried in a suitable frame, and one edge of the frame, usually the lower edge 12, can slide longitudinally along the frame holder and be clamped in any desired position between the extreme limits by means of a clamping screw 14.



The base piece can be slid along and turned round axially relative to the blowpipe. The supporting rod and its clamping screw in the base plate allows the distance of the frame from the blowpipe to be adjusted, while by turning the supporting rod relative to the base plate the plane of the frame can be adjusted about one axis. The joint between the top of the supporting rod and the frame holder enables the plane of the frame to be adjusted about an axis at right angles to the axis previously mentioned. The screen can be adjusted in its own plane along the holder. By means of these adjustments the screen can be quickly set in any desired position relative to the flame of the blowpipe.

The above described supporting means may be said to constitute a universally adjustable stand for the screen. It is evident that a simpler stand may be made in accordance with the invention. In one form of such simpler stand, Figs. 1, 2 and 3, a single spring clip and a short rod integrally fastened to it form the base piece. The top of the rod is jointed to the frame holder by a ball and socket joint, a clamping screw 8 being provided. This simpler stand possesses all the adjustments previously mentioned, except the independent adjustment of the distance of the screen from the blowpipe.—D. R.
—Acetylene & Welding Journal (London).

ENGLISH ARC WELDING

Alloy Welding Process, Ltd., 149 Leadenhall St., London, England, have just published Bulletins Nos. 10, 27 and 31.

Bulletin No. 10 refers generally to the applications of arc welding and includes a table showing comparative costs of welding by oxy-acetylene and electric arc.

Bulletin No. 27 contains some interesting information as to the various types of plant available for arc welding, their design depending upon the power supply available and the number of operators it is desired to employ. Any firm thinking of installing arc welding plant or extending their present installations will find this list of considerable interest. We would draw especial attention to the comparatively low cost and convenience of A. C. transformer plant where an A. C. supply is available.

Bulletin No. 31 is a price list of "'A. W. P." welding materials and electrodes. Standard electrodes are already well known, but the results obtainable with various special electrodes have been confined hitherto to a limited number of engineers. Now however that their success has been demonstrated convincingly in more than one case it has been decided to standardize ten different types of special electrodes for alloy steels and these are included in this list.

Especial attention is drawn to self-hardening electrode, a manganese electrode depositing a hard metal and which is proving of great value for tramway permanent way repairs and which has a large field for all repair work where the welded or built up portions have to withstand hard wear.

The "A. W. P." cast-iron electrode is probably the most valuable development in arc welding that has occurred in the last two years and it is claimed that its use will lead to a very large increase in the use of arc welding for cast-iron repair work. It represents quite a novel type of electrode for this work and although not composed of cast-iron (such electrodes being quite unsuitable for use with the metal arc) it actually deposits a high-grade cast-iron in the weld.

Capt. James Caldwell, who visited the United States during the war, is director of this company.

The Maurice Ledoux & Company, 10, Place du Vieux Marche, Bordeaux, France, are interested in securing catalogues of American welding apparatus including regulators, supplies and accessories. Prices are requested f. o. b. New York, payment to be against document through a New York bank.

The New Thumb Button!

MILBURN Oxy-Acetylene Torches

THERE is the new thumb button control valve—right at the end of the handle barrel of Milburn cutting and combination (Cut-Weld) torches. See the picture. Can't you just imagine the speed and convenience of the thumb control? Grasp the torch and put your thumb on the button. A slight pressure, and the cutting oxygen is in action. The cutting oxygen is shut off immediately on releasing the thumb, or you can click the button into place and the cutting oxygen will stay in action as long as you please without sustained pressure from your thumb.

This is only an added advantage in Milburn cutting and combination torches. It serves to illustrate the advanced design and construction which is used throughout all Milburn torches. They work with the highest efficiency, with great economy of gas, and, because of the advanced design, are absolutely free from flash back. You can plunge the tip of a Milburn torch directly into the molten metal—it will not flash back—it welds on just the same.

Write for complete information regarding the Milburn Oxy-Acetylene line—everything from the smallest jeweler's torch to large industrial acetylene generating plants. Ask for Booklet No. 35.

Milburn Acetylene Lights are the right lights for night work. Write for Booklet No. 25.

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BALTIMORE, MARYLAND

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VOLUME 5. JANUARY, 1920. NUMBER 1.

When you meet a friend, don't pat him on the back—try his hip.

Cost-plus

UPON what basis should the owner of a job welding shop make his charges? Should he charge on a basis of cost, plus a good profit, or should he charge all the traffic will bear? In other words, should he soak a customer when he thinks he can get away with it? Aside from good workmanship, what is the secret of success of the successful job welding shop? A friend tells us a successful and money-making shop can not be run on a cost-plus basis. He says the man who trys it will bust. Our friend thinks the percentage of failures, no matter how small, will upset the job welder's calculations and eat up his profits.

We don't think so. We believe that autogenous welding is a sound, legitimate business, and one which should be operated on clean, business-like lines. It's not good business to charge Smith any more for the same piece of work than you would charge Jones, unless perhaps, Smith was a garage owner and sent you a lot of work, in which case he is your jobber and entitled to a lower price. Of course, a great many people want you to give an estimate on a piece of work. They want to know in advance absolutely what the cost will be. In such a case, of course the cost-plus plan won't work. But as a general rule, will the cost-plus idea work out? We would like to hear from our readers on this point. Our friend says "there ain't no such animal."

Cost Records

AT the close of 1919 we wonder how many of our job welding friends can tell us what it cost to do business during the year. We asked one man the same question and he tells us it would be easier to tell us what he spent. Cost records have always been an important factor in any successful business, but in these days of high prices, they are doubly important. How much did your gases cost you? What did you pay out for rods and flux. Did you keep a record of charcoal and city gas consumption? In other words, have you any sort of an accounting system? You need just enough of a book-keeping system in your business to enable you to spot any little weakness which is costing you money. If you haven't got it, we advise you to start the new year right.

Firebox Welding.

THE eighth annual report of the Chief Inspector of the Bureau of Locomotive Inspection, which covers the year ending June 30, 1919, has just been published. It contains some recommendations not at all complimentary to autogenous welding. Until some responsible body assumes control and jurisdiction over welders who are allowed to perform this class of welding we may expect to be confronted by such distressing reports. We in the welding trade are inclined to drift along in smug complacency, strong in our belief that autogenous welding can do no wrong. It can't—when a *real* welder is on the job, but until we take steps to safeguard the good name of our craft, we may expect to be blamed for all sorts of accidents. Extracts from the report follows:

* * * The increase in the number of persons killed during the last year, over the year previous, is, to a considerable extent, due to some very violent explosions which occurred because of fire box crown sheet failures, which serve to illustrate the prime importance of proper fire box construction, inspection and repair, together with the location, inspection and maintenance of such appliances as water glasses, gage cocks, injectors, steam gages and safety valves, upon which to a very great extent, rest the safety of locomotive boiler operation.

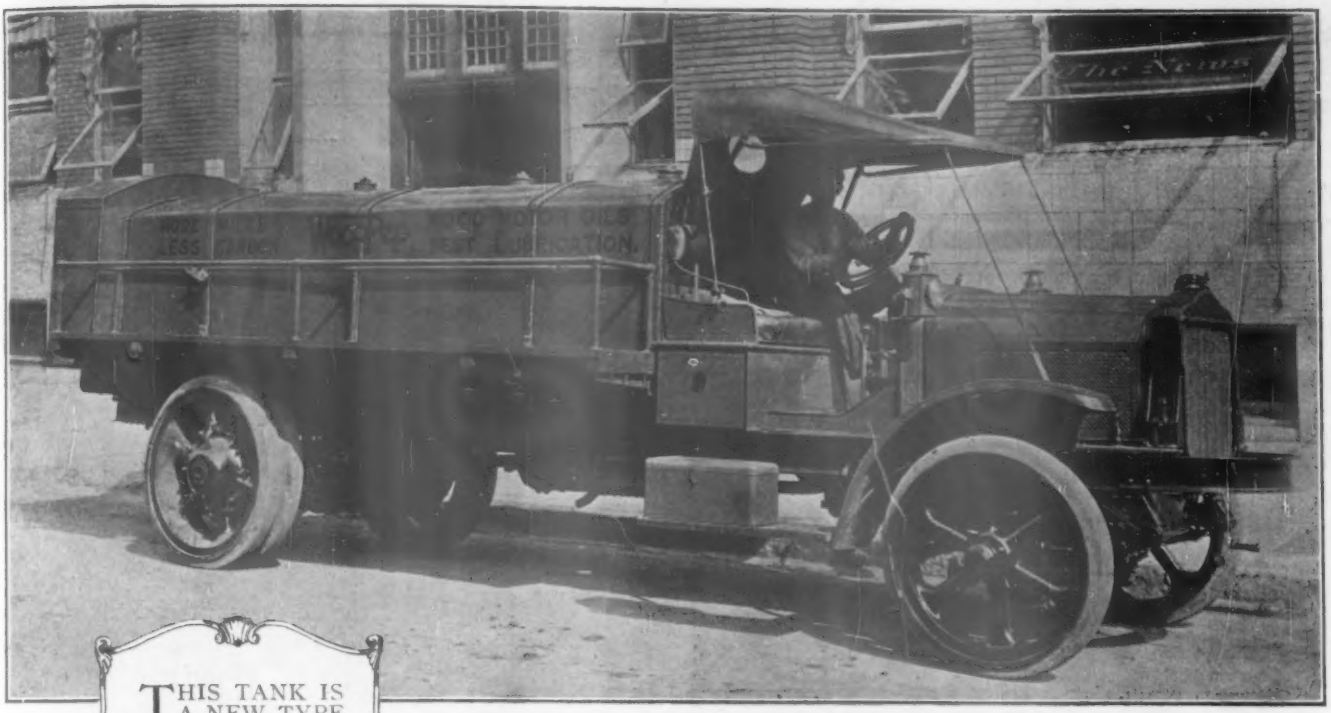
While some of these explosions were primarily caused by low water, it is believed that their violence and consequent results were greatly increased by failure of crown sheet seams which had been welded by the autogenous process. The failure of such seams, which have come into extensive use during the past few years, in most cases evidently caused the initial rupture and, in some cases, occurred with slight overheating.

Investigation of these accidents indicated that the failure of the welds occurred with a higher level of water in the boiler, and consequently a lower temperature in the sheet, than in other cases where the crown sheets failed and did not tear.

It will be recognized that the force of a boiler explosion depends upon the extent and suddenness of the initial rupture, together with the volume and temperature of the water in the boiler at the time of explosion. This feature is clearly brought out in the illustrations showing fire boxes which have failed in actual service.

It is true that not all autogenously welded fire box seams fail at the time of boiler explosion, but inasmuch as our records show that 80 per cent of all such welds involved have failed under such conditions, it is believed that, until some way has been discovered through which the quality and tenacity of a weld so made may be established in advance of its failure, fire box crown sheet seams so constructed should be avoided, where overheating and failure are liable to occur, and that autogenous welding should not be used where the strength of the structure is dependent upon the weld, nor where the strain, to which the structure is subjected, is not carried by other construction; nor in any part of a locomotive boiler wholly in tension while under working conditions. * * *

Up to this time four states have ruled against autogenous welding, as applied to boiler or pressure welding. These states are: California, Michigan, Massachusetts and Indiana. There would appear to be some organized effort behind this movement, for following the recent decision of the Indiana Boiler Inspector and the report of the Bureau of Locomotive Inspection, comes a general letter from the chief inspector of



THIS TANK IS A NEW TYPE OF ONE-PIECE CONSTRUCTION WHICH WAS ESPECIALLY BUILT BY THE WELDED PRODUCTS CO., BIRMINGHAM, ALABAMA, TO CARRY WOCO MOTOR OILS.

Truck Held Together By Welded Tank When Side Frame Breaks

THE 1,000 gallon, 4 compartment oil tank on this 3½ ton chassis is oxy-acetylene welded in every seam.

It was built to carry heavy loads over southern country roads that "treat 'em rough". The beauty and finish of the tank work are undeniable.

Its strength was amply proven on a recent trip when the rear end of the truck dropped into a deep ditch and one of the 6-inch channel side-frame members snapped clean through. But——

So strong and rigid was the welded tank that, from its 3-point suspension, it held the truck together and permitted it to run to the repair shop on its own power, supported by the tank.

Prest-O-Lite

DISSOLVED ACETYLENE

in its convenient portable cylinders is every day opening up to manufacturers new and important economies in metal working through the use of the oxy-acetylene process.

Why not tell Prest-O-Lite Engineers what sort of metal work you do? Very likely they can help you to make it stronger, better—and cheaper.

THE PREST-O-LITE COMPANY, Inc., 30 East 42nd Street, New York
Kohl Building, San Francisco
In Canada, Prest-O-Lite Co. of Canada, Limited, Toronto

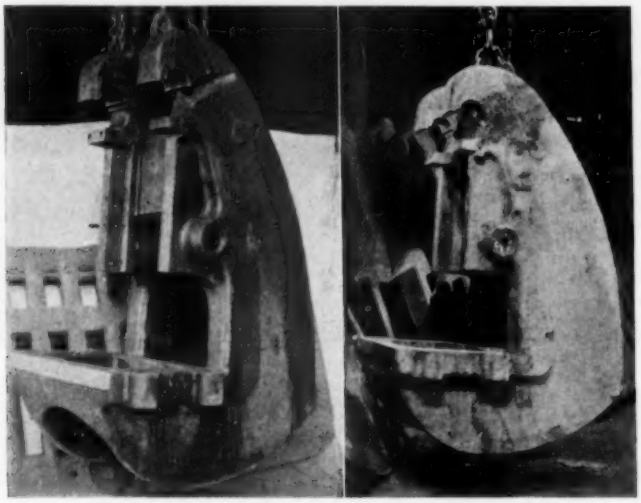
7419

a big insurance company, to his inspectors, in which he seriously critizes autogenous.

As we said last month—let's hang together.

WELDING A PUNCH PRESS FRAME.

Mr. Walter J. J. Newell, of the Newell Welding Works, Utica, N. Y., has had some unusual success in welding punch press frames. The illustrations show one of five big frames welded for the Savage Arms Corp., of Utica. The welding was done in November and December, 1918, and the machines have been in constant use ever since in the manufacture of Lewis machine guns. The machines operate 24 hours a day.



Welded Punch Press Frame

They each weigh from two to two and one-half tons and it required approximately 36 hours to make the necessary repairs and put the machines back into operation. A weld or any part of a punch press frame is bound to be subject to the most severe sort of a test and the fact that these machines have stood up for at least a year after welding is not only a fine testimonial as to the reliability of oxy-acetylene welds, but it is also evidence that the Newell Welding Works employ competent welders.

D-B LEAD BURNING OUTFIT

The Davis-Bournonville Co., have published a bulletin on the subject of lead burning, that is of considerable interest to manufacturers and users of acid tanks, chemical apparatus, and all lead work that must be autogenously welded.

Although lead burning is a special trade and considerable skill is required on some classes of work, it is not difficult to learn and manufacturers are beginning to realize the possibility of training a few of their own workmen to fabricate and repair lead apparatus, thus making them independent of specialists who command high wages.

In this bulletin the Davis-Bournonville Company furnishes three distinct outfits as regards the gases. City illuminating gas and oxygen or compressed air are used successfully for storage battery connection work as are also acetylene and oxygen.

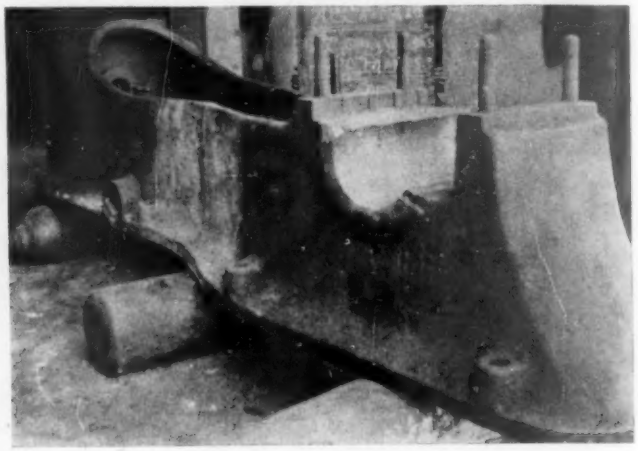
Acetylene may be used for all classes of lead burning including tank linings.

Hydrogen is preferred by some of the older expert burners on sheet lead work, and this demand is provided for by hydrogen compressed in cylinders and furnished with special pressure regulators.

The outfits are comparatively inexpensive and any concern having even a modern amount of lead apparatus will find it advantageous to provide an outfit and train one of its oxy-acetylene operators to take care of repairs.

WELDING A STEAM ENGINE HEAD.

The accompanying illustration shows a 3,600-pound casting, or, in fact, a steam engine head welded by Mr. A. C. Carlisle, of Macon, Ga. This engine head was broke when the generator balls ran off and let the engine run away. The casting was broke about 3 feet from the fly wheel shaft. The line of the weld measured 50 inches and the casting was 2½ inches thick and 4 inches wide. The job was started in the morning and finished the following morning. The casting



Welded Engine Head.

was first hoisted to a welding bench with chain hoists. Then two 4 by 4 wooden blocks, wrapped up in asbestos paper, were placed 2 feet from each side of the crack. The chain hoists being used at the respective ends of the two broken parts. A fire brick furnace was then built between the two blocks around the line of the weld, a door being arranged on each side of the casting. As the casting was raised from the bench, the frame from the two pre-heating torches was allowed to entirely encircle the casting. The job turned out very successful and is in constant daily service.

WELDING PEWTER

Who among the readers of *The Welding Engineer* has had experience and success in welding pewter, and how was it done? Who has welded Franklin Metal (white metal), such as is often found in automobile pumps?

The Northwest's Greatest Auto Show will be held at Minneapolis, January 31st to February 7th.

The Victor Oxy-Acteylene Equipment Company, San Francisco, have opened a branch office at 105 W. Monroe St., Chicago. Offices will be opened in other mid-western cities.

In the yards of the Pacific Gas and Electric Company, San Francisco, a four inch square billet was recently cut with oxy-street gas in one minute, 51½ seconds, with a consumption of ten feet of oxygen and six feet of street gas. The street gas came from a container under fifteen pounds pressure. The oxygen cost 1½c per foot and the oxygen 6c. The cut was made in the open. The Columbia Steel Company, Pittsburgh, Calif. and the Moore Ship Building Company, Oakland Creek, Calif. are also cutting billets by this method.

The Page Steel & Wire Co. are marketing a line of manganese steel welding rods. These rods contain in the neighborhood of 12 per cent manganese.

LINCOLN ARC WELDER

Take The Welder To The Job

You can take this Gasoline Driven Lincoln Arc Welder *right to the job.* It is a self contained unit.

This Lincoln equipment enables you to take the welder to the job. It carries its own engine driven welding generator, and can go anywhere.

There are hundreds of big profitable jobs which it can do for you—jobs which cannot be brought to your shops—work which must be done in position.

Whether it is an emergency repair at a dry dock or ship yard, a broken machine tool in a factory, or any other of the many rush jobs which pay big money, this Lincoln equipment is ready to go out to the spot at a moment's notice.

It is independent of power supply. It has its own engine for driving the welding generator. It can carry everything you need for the work. It can go anywhere.

Why not go after the *big* jobs?

Write for Bulletin 104-W

This standard Lincoln Motor operated over 3 years under water without damage.

The Lincoln Electric Co.

Cleveland, Ohio

New York City, Buffalo, Syracuse, Cincinnati, Chicago, Detroit, Baltimore, Columbus, Pittsburgh, Philadelphia, San Francisco, Boston, Charlotte, N. C., Minneapolis

The Lincoln Electric Co., of Canada, Ltd., Toronto-Montreal

Agencies in other principal cities

REPAIRING *a* LIGHTHOUSE FOUNDATION *by* THERMIT WELDING

During the arctic winter of 1917-1918 when zero weather paid frequent visits, even to the Carolinas, a most unusual accident happened to Wade Point Lighthouse, which is situated one mile from shore in the northeasterly part of Albemarle Sound, N. C.

Nature of the Injury

A large ice-flow which had formed in Albemarle Sound became detached by a terrific gale and was driven with great force against the five cast-iron columns which support the superstructure of Wade Point Lighthouse in a depth of nine feet of water. So great was the pressure of the ice after it had piled up on one side of the structure, that the columns were bent over in a northwesterly direction and broken through, the columns below the breaks standing at an angle of about 20 degrees with the vertical. The northeast center and southwest columns broke just above the lower sockets. The southeast and northwest columns broke respectively 18 inches and 6 inches above the socket.

Wade Point Lighthouse.

Fortunately the strong iron tie rods underneath which held the supporting frame together prevented the lighthouse from collapsing. Although the lower part of the broken columns had been thrown over into an inclined position, the upper part of the structure, including the lighthouse proper, remained vertical.

Repairing Methods Considered

The Lighthouse Service was unable, until recently, to undertake any repairs on the Lighthouse. During the 15 months after the accident the station dwelling was not occupied by the keeper who attended to the light from a nearby city. At the end of this period temporary repairs were made by driving wooden piles and placing supports underneath the structure.

When the question of making a permanent repair was under discussion, two plans were considered; one for rebuilding the station along the original lines and the other to transfer the present superstructure to a concrete caisson placed close by and secured to the site by piles driven through the bottom of the caisson, the structures in both plans to be heavily riprapped. The cost of repairing the lighthouse by the reconstruction of piling was estimated by the Lighthouse Service at approximately $13,000, while the cost of a completely new structure upon which the present superstructure coud have been moved was estimated at approximately $30,000. But bids in both cases were so excessive that it was decided to repair the columns of the old structure by Thermit welding.

Owing to the isolated situation of the lighthouse all welding materials were transported from Norfolk, Va., by a small steamer which was moored by the lighthouse during the welding operation and served as quarters for the men.

General Nature of the Thermit Process

To those who are unfamiliar with the thermit process, it may be explained that thermit is a mixture of aluminum and iron oxide. This mixture can be ignited by means of special ignition powder and a reaction produces superheated liquid steel and slag (aluminum oxide, at a temperature of approximately 5,000 degrees F. This thermit steel is sufficiently hot to melt and dissolve any metal when it comes in contact with and amalgamates with it to form a solid homogeneous mass when cool. In making welds by the thermit process the parts to be united are surrounded by a mold and the section heated red hot by means of a special preheater after which the thermit steel is poured into the mold.

Jacking Up Lighthouse

The first problem consisted in jacking up the superstructure in order to remove the weight from each column successively, as it was being welded, also to control the allowance for contraction of the weld. As the jacks on hand proved to be too light to support the lighthouse, it was necessary to obtain a 50-ton rachet jack from Elizabeth City, N. C., the nearest available place.

The lighthouse was packed up in the following manner: two 8 foot by 8 foot timbers were laid side by side near the corner of the house and across the top of the iron tie rods which connected the columns together. The jack was set on these timbers and on the head of the jack was placed a wooden structure of 10 foot by 10 foot timbers which in turn supported an oak cross-beam on which 15 in I beams supporting the lighthouse, rested. To prevent sideplay when the jack was raised, the structure had to be further secured in place by means of chains. The structure above the jack was lifted during each weld so that the upper part of each broken column was raised $\frac{1}{8}$-inch as an allowance for contraction. The jack was lowered again during the first and second hours, after pouring each weld until the column finally supported this original weight.

Cutting Out Spaces at the Broken Sections

Having jacked up the column the next step was to cut out about one 1½ inch gap between the broken sections, to allow for the thermit steel to enter. Since in each case the inclination of the lower part of the column had already provided a sufficient gap half way through this section (except in one case where the column had snapped back into place) it was only necessary to drill a series of three $\frac{3}{8}$-inch diameter holes ¼-inch apart by means of an electric drill with power supplied from a dynamo on the steamer, then knock out with hammer and chisel, the metal remaining between the line of holes and the break.

Constructing the Mold

As the columns were hollow with walls 1½ inch thick, the interior spaces were filled with molding and facing sand for the thermit steel mold, for a depth of about three to five feet below the weld at which point a flange extended horizontally

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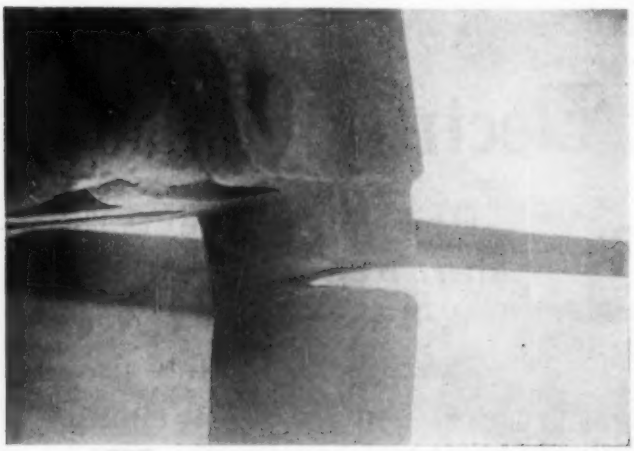
through the column. First it was necessary, however, to remove about two feet of water which had collected in those spaces through rise and fall of the tides in order to prevent steam from being formed from the heat generated by pouring the molten steel into the weld and thus injuring the mold. This water could not be siphoned out because part of it was below sea level. An oval hole two inches wide and three inches long



Broken Column.

was therefore drilled out of the column about 15 inches above the break and the water removed through the hole.

Packing the molding sand inside the column was also a very slow process as the ramming had to be done with a bent rod inserted through the hole without the interior being visible to the operator, whose working facilities were cramped by the peculiar construction of the lighthouse, and consisted at times of only a board suspended by ropes hung from a railing above, as shown in an illustration. When the upper section was rammed up rope was wrapped around the break to prevent escape of sand. Facing sand was inserted for six inches above and six inches below the break.

After the column was rammed up to a height of one foot above the break, the sand at the break was removed with a

Break in Central Column.

trowel and yellow wax applied to form a pattern. The wax was inserted 1½ inches within the inside of both upper and lower sections and shaped around the outside of the break in the form of a tapering collar six inches wide and ¾-inch thick at its center.

In constructing a mold box its base consisted of two plates fitted around the column and supported partly by tie rods and partly by three knee-irons bolted to the column. The mold box was 18 inches deep, 24 inches wide and 36 inches long, its length being sufficient to project under a crucible. The pouring gate pattern was set diagonally outwards, while two heating gate patterns were placed horizontally against opposite sides of the wax pattern in order to give proper circulation to the preheating flames.

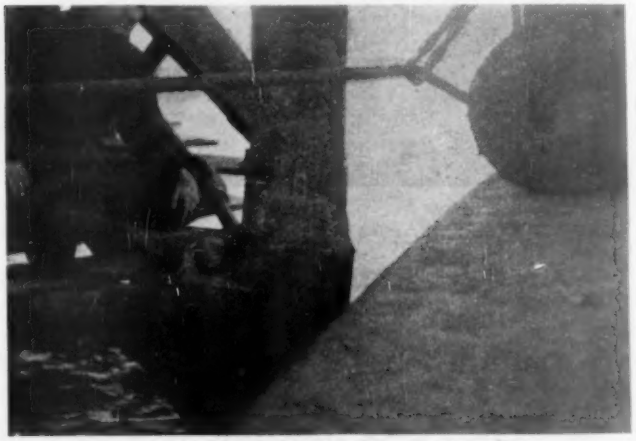
Four riser patterns consisting of wooden blocks 10 inches long and of 1½-inch by 3-inch sections were inserted with bevelled edges against the wax pattern and slanted upwards and outwards. The risers formed from this pattern served to feed Thermit steel into the weld when the metal in the contracted just after pouring, thus taking care of all shrinkage in the weld. Additional riser patterns in the form of small pieces of wood 1¼-inch thick and 1 inch wide were placed against the column vertically above the wax for the purpose of preventing the walls above the weld from sloughing away, also to afford escape of gases. The arrangement of these small risers is shown in the illustration of the finished welds.

Preheating the Mold

The sections were preheated by means of two kerosene torches supplied with compressed air from apparatus on the steamer. The preheating took in each case from 2½ to 3 hours.

The Thermit Reaction

The lighthouse was amply protected from any possibility of



Finished Weld.

catching fire during the Thermit reaction by shielding all exposed parts in the house with asbestos sheets.

The crucible used for the reaction was supported on a tripod the feet of which rested on the temporary wooden staging. When the crucible was set securely in place over the pouring gate of the mold box the ignition powder which lay on the top of the Thermit in the crucible was ignited and the Thermit reaction thus started.

In spite of the intense heat of the reaction no injury occurred to the lighthouse.

East weld was allowed ample time to cool, after which the mold box surrounding the weld was dismantled and the Thermit steel pouring and heating gates and risers cut off.

The welds, all of which proved entirely satisfactory, required from 125 to 175 pounds of Thermit, according to the size of opening cut out, making a total of 750 pounds for the five columns.

It will be noticed in the illustration that the columns were welded together in their bent position, no attempt having been made to straighten them, as it was impossible to force the piles back to their original position, and if the cast-iron columns themselves had been bent they would have broken off.

The actual time consumed in making the five welds was a little less than three weeks.

BOILER WELDING

By Ben K. Smith*

In this field the process of oxy-acetylene welding and cutting offers splendid advantages to the boiler shops. Before going into details of welding boilers, it is necessary to outline the history and construction of boilers.

A steam boiler consists of a vessel to contain the water and the steam after it is formed; a fire-box to contain the fire, tubes, flues, and uptake to transmit heat and conduct the hot gases from the fire to the chimney, and various fittings to facilitate safe and economical operation. One of the most important safety fittings are *stay bolts*. They hold two parallel straight sheets rigidly, so as to hold the required high pressure without bulging. Under the same principle crown bolts and radius bolts are employed. On all modern boilers it is unlawful to put in stay bolts without having small ⅛ or $\frac{3}{16}$ holes drilled in the centre of bolt about 1½ inches deep. These are called telltale holes, because if they happen to break inside the water or steam space, the latter will leak through the telltale hole and thus indicate a broken bolt. It is also against the law to weld any leaky stay bolts to the sheet.

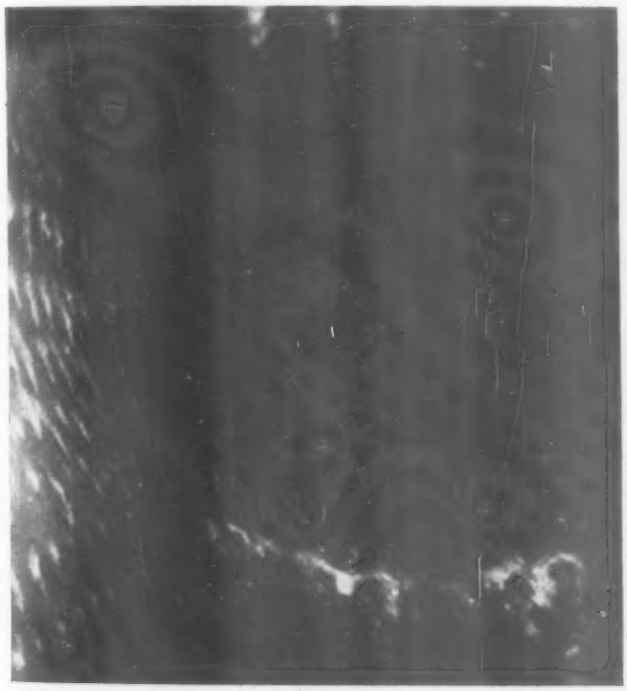


Fig. 1.

Cast-iron was the material of which the earliest forms of boilers were made, but an account of its low tensile strength and its unreliable nature, it is now used very little.

Wrought iron, up to about 1873, was the principal material used for boiler plates. It is a pure iron prepared from pig iron by a process called puddling; and is well adapted for use in boiler construction, as it is strong, tough, and fibrous, and combines high tensile strength with durability and freedom from brittleness.

Steel has entirely displaced iron for boiler work. Boiler steel is made by the open hearth process, and contains for ordinary thickness of one inch, 0.25 per cent carbon, while thinner plates of ¼-inch contain about 0.15 per cent carbon. Larger percentages of carbon, while accompanied by an increase in tensile strength, lessen ductility. The best boiler material at present has the following properties: great tensile strength, ductility, homogeneity, toughness, freedom from blisters and internal unsoundness. Its tensile strength is from 55,000 to 65,000 pounds per square inch, with an elongation of 25 per cent. Therefore, in making small or large welding repairs on a boiler, one should insist on the use of proper boiler plate or fire box steel that will have the above mentioned qualifications.

The Riveting Process

Riveting, which without doubt will be used for a long time, is becoming gradually obsolete. The riveting process consists of lapping two sheets together, riveted and corked at the edges. These sheets have a mill scale, which is a non-conductor of heat and unless the scale is ground off from the lapped joints, it will act as a barrier between both sheets, preventing the water from absorbing heat from the outside lap, with the consequence that fire cracks, steam burnt plates, leaks and corrosion occur. With the riveted seam one has to expect a continuous expense of maintenance in corking every so often and when there is no corking edge left, then the sheets or an entire boiler is scrapped.

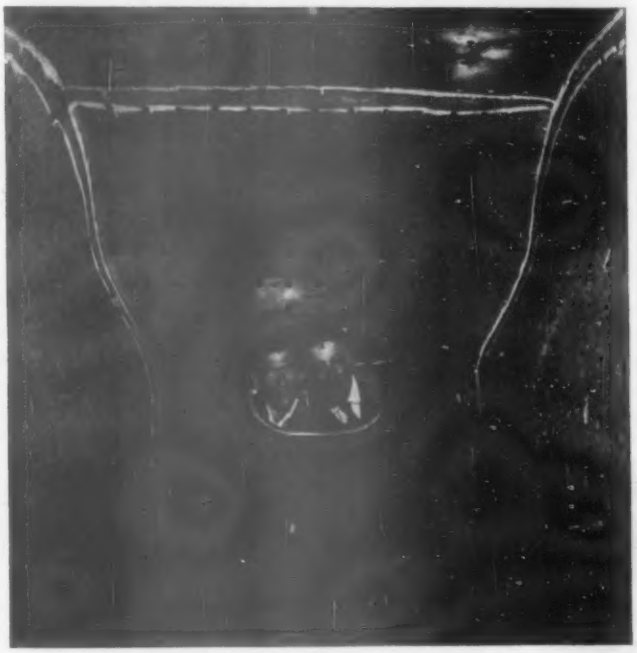


Fig. 2.

The Welding Process

The welding process conssits of. joining two plates by butt welding the edges. A welded boiler may be called a seamless boiler and the plates throughout will have a uniform thickness. By the use of welded joints, the deposits which accumulate on and around rivet heads and joints, corrosion caused by leakage, calking and loose rivets, are done away with. In heating a welded fire box, the water will protect the sheet on its entire surface. It eliminates fire cracks, steam burnt plates and corking. A welded joint must be 100 per cent tight, or it is no good at all. The cost of a welded joint is in many cases lower than the riveted joint and when time is considered as an import-

*Welding Engineer, United States Welding Company, Minneapolis, Minnesota.

ant factor, then the welded joint can save days and sometimes weeks if compared with the time taken up by the boiler makers with their method.

The Operator

The first thing to be considered in starting boiler welding, is

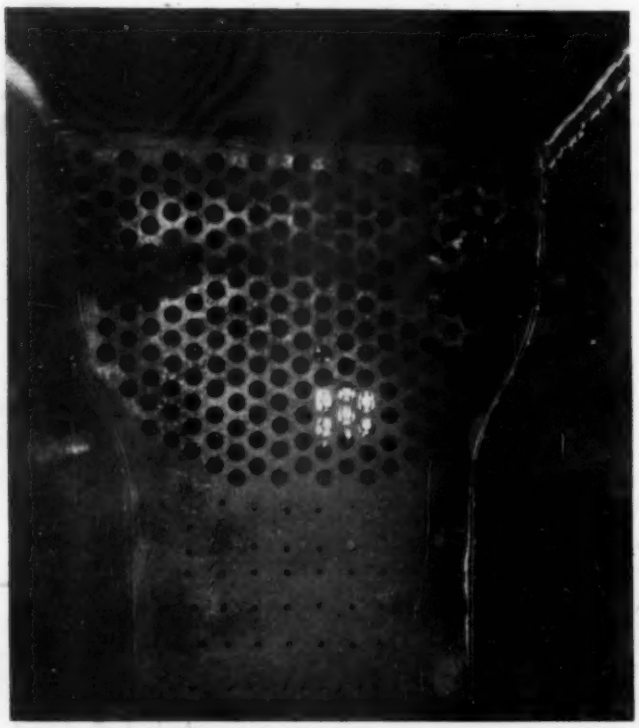


Fig. 3.

the operator himself. He must be a conscientious worker and must have some knowledge of boiler construction. Moreover one must not attempt to experiment directly on boilers, but should practice welding cracks or patches on some scrap sheets or condemned boilers in a horizontal position. Next practice

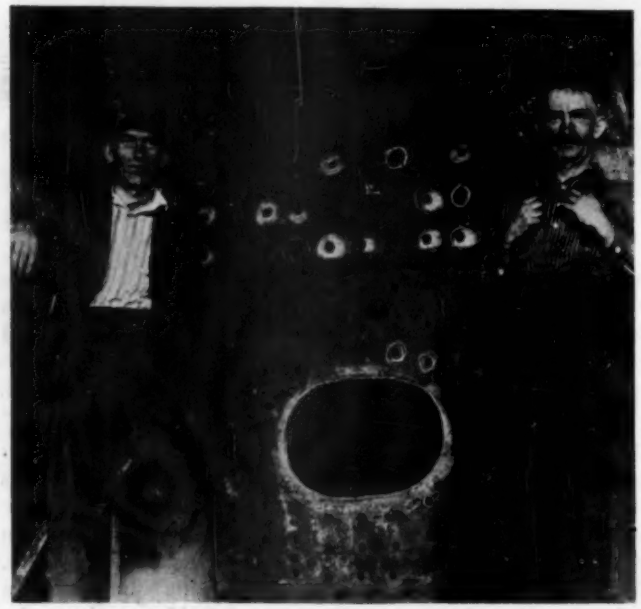


Fig. 4.

vertical welding and at last one may experiment with overhead welding.

Bevelling

All welding on boiler plates must be bevelled to a 45-degree angle. The bevel may be cut with the cutting torch, as it will save a great deal of time, but the scale or any oxydation left on the edges must be cleaned off with a hammer and chisel. In addition to the bevelling, the edges to be welded should be separated from $\frac{1}{8}$ to $\frac{3}{16}$ inches. This is absolutely necessary if one desires a thorough weld.

Adjustment

The maintaining or clamping in position of the parts to be welded is of great importance in boiler work. Failure to adjust the patch or sheet to be welded exactly at the same level or distance with the solid piece will retard the progress of the work and will decrease the strength of the weld. Stay bolts screwed in from the outside and clamps placed on the inside of sheets will keep a side sheet level. Small wedges made of harder steel will keep the edges separated. A few bolts at the mud ring will keep the sheet from raising or warping. Furthermore considering the expansion and contraction that is bound to occur, one must use the best judgment as to the preparing and adjustment of the plate to be welded.

Welding Rod

A very important factor in successful gas welding is the use

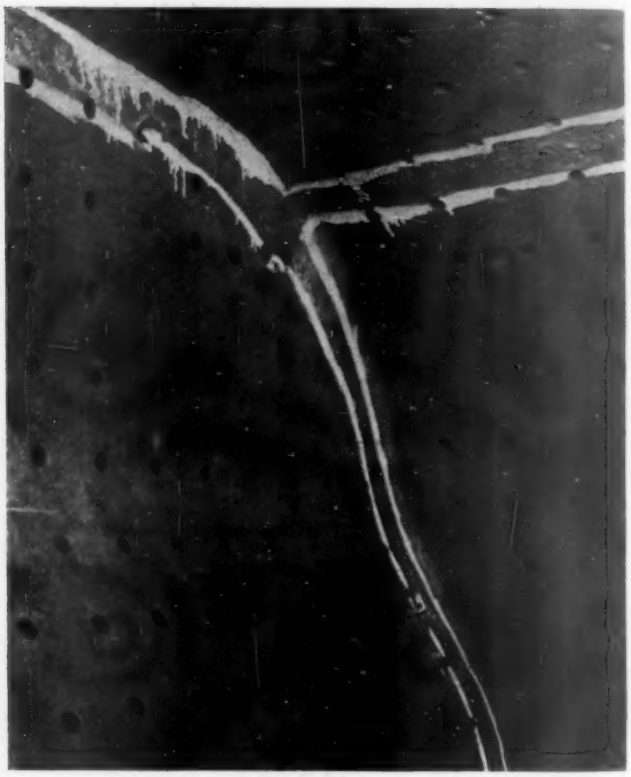


Fig. 5.

of suitable welding rods. Although very often overlooked, many failures in welding can be traced to poor welding material.

A good welding rod is one that is as pure as possible. In welding boiler plate the property of elongation is lowered in the weldling line, because the metal after fusing becomes a cast metal, therefore the purer the welding rod, the less foreign element it contains, such as sulphur, phosphorous or slag, the more it possesses the property of elongation after welding.

Expansion and Contraction

Metal plates will expand or increase in volume under the action of heat and on cooling they contract or return to their original volume. If the heating is done slowly and is cooled in the same way, the effects of expansion and contraction, such as breaking or warping, are not to be feared, since its action is uniform. This cannot be done in boiler work as we cannot preheat the whole boiler or part of it when welding a patch or crack. On boiler welding the heat must be applied at one point. The metal tries to expand at this point and since no force

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CONTENTS

Introduction.
I. Apparatus.
II. Operation.
III. Shop Equipment.
IV. Apparatus repairs.
V. Preheating Agencies.
VI. Part One—Welding of Cast Iron.
Part Two—Welding of Cast Iron.
Part Three—Welding of Cast Iron.
Part Four—Welding of Cast Iron.
VII. Part One — Steel Welding.
Part Two — Steel Welding.
Part Three — Steel Welding.
Part Four — Steel Welding.
VIII. Brass Welding.
IX. Part One — Aluminum Welding.
Part Two — Aluminum Welding.
Part Three—Aluminum Welding.
X. Welding of Malleable Iron.
XI. Oxy-Acetylene Cutting.
XII. Carbon Burning.
Glossary.
Index.

can stop expansion, it breaks or deforms the part which opposes it. Furthermore, the contraction on cooling forms the opposite strains and brings the same results. Since the metal in boilers possesses the property of elongation, the effects of expansion or contraction are not to be feared as much as those that have not. Of course, these effects vary according to the shape and place of plate. If the expansion can take place

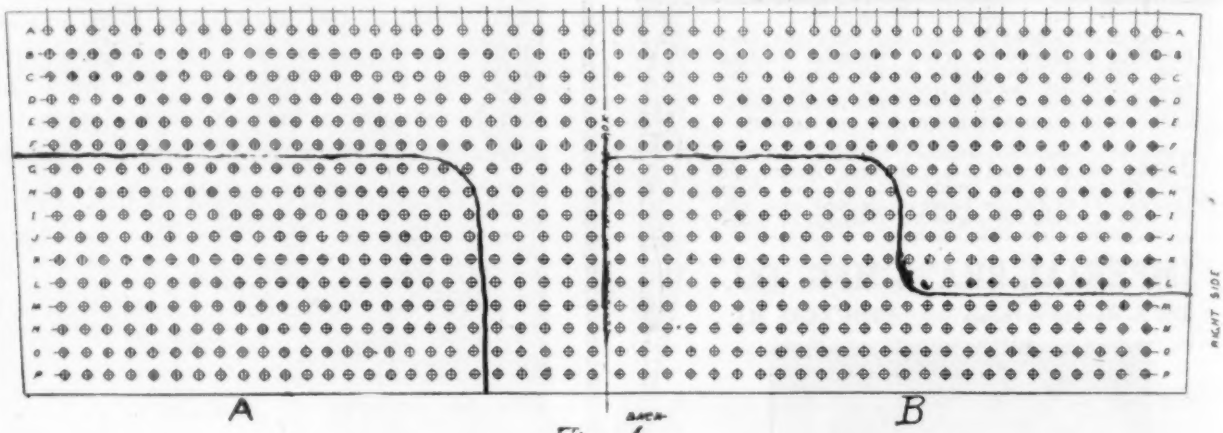

Fig 6

in one or two directions, the strain or deformation can be carried to these points. On the contrary, if it is imprisoned in a solid sheet, it exercises its efforts at the point which stops it and may break the metal at this part. There is no use trying to oppose expansion and contraction by force; nor can we ever measure or know how much of a strain is left in the welded plates.

What the operator can do is to avoid or limit the consequences. However, the author has found that there is no such a thing as not being able to take care of expansion and contraction on boiler welding, therefore, the boiler welding operators need reflection and good judgment almost at every weld, because every job presents a different problem, and success depends on solving it right before the weld is attempted.

A Few Points in Welding

The author has had the opportunity in the past to employ and examine a great number of boiler welders, and has found three classes of them. 1. The one who has not sufficient heat at the end of his tip; 2, The one who has a rigid flame or too much heat at the end of his tip; 3, The one who has reached the happy medium of heat and has a soft and controllable flame at the end of his tip. The welder that has not sufficient heat at the end of his tip will fuse his welding rod to the scale of the bevelled plates, because the scale fuses to about 300 degrees less than the steel itself, and as the former resembles the molten steel, the welder is deceived and is fusing the welding rod into the scale or oxide of iron instead of to the steel. The consequences are that the welds will open up again or will crack at the least little strain.

The second class of welder who has a rigid flame or too much heat at the end of his tips has a hard time keeping the molten metal where it is intended. It will run here and there and yet leave a hole in the center of the bevel. To close this hole some welders will place the end of the welding rod into the cavity and fuse metal around it so as to cover the defect. The reader can imagine the result of such a weld.

The third class of welder has the easiest method of all and has the best success. With a soft flamé, yet hot enough to fuse the edges and the welding rod continuously, the welder makes a steel to steel weld and is able to control the molten metal and cause it to lay where it is necessary.

An experienced boiler welder will move the torch in a half circular movement around the welding rods and move the welding rod after the flame. Both torch and rod are moved continuously. The one that is holding his torch in one spot trying to fuse that spot only for welding purposes, will make a hole on that spot and cover it up with cold metal. It is absolutely necessary to keep both torch and rod on the circular movement from one side to the other without haste or stop until a sufficient layer of steel is fused in the bevel. Then the torch is moved forward, slowly and with great care, so as to obtain in succession a continuous and regular weld. In order to accom-

(Continued on Page 57)

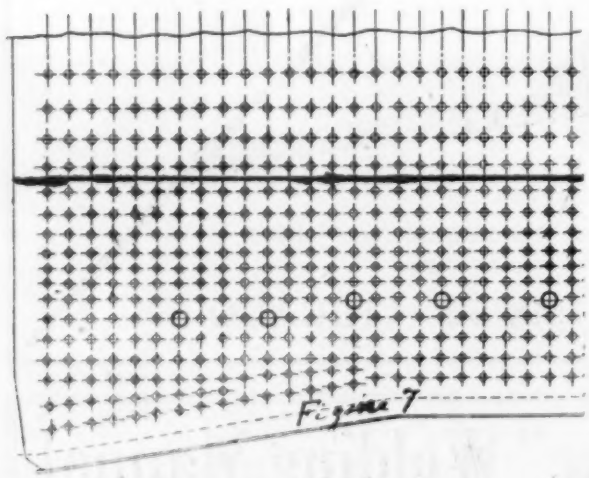

Figure 7

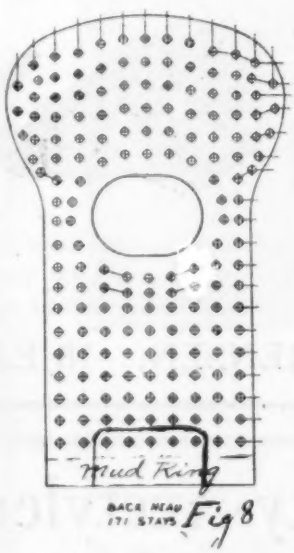

Fig 8

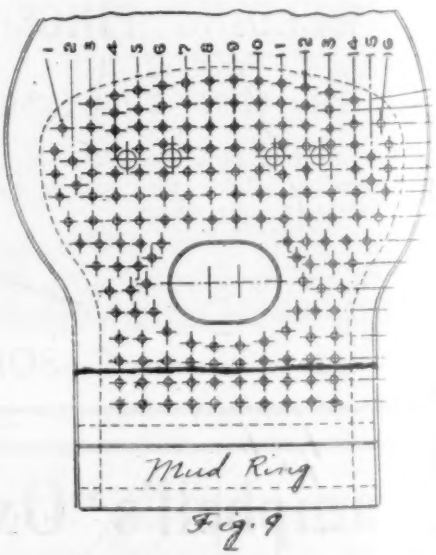

Fig. 9

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Providence, R. I.—Rhode Island Score Filling Co., 173 Eddy
Raleigh, N. C.—Republic Service Co., 108 S. Blount St.
Richmond, Va.—F. D. Schluter Auto, 1009 W. Broad St.
St. Louis, Mo.—Scored Cylinder Wks., 325 N. Jefferson Ave.
Savannah, Ga.—H. W. Smith, Bay & Price Sts.
Schenectady, N. Y.—Franken Welding Co., 5 Villa Rd.
Shreveport, La.—The Bain-Braird Welding Co.
Springfield, Mass.—Hoag Welding Co., 31 E. Court St.
Springfield, Ill.—Romie Fields, 317 South Third St.
Troy, N. Y.—Reliable Auto Repair Shop, 229 River St.
Tampa, Fla.—R. G. Wood.
Washington, D. C.—Day Welding Co., 43 Summer, N. W.
Worcester, Mass.—Central Welding Mfg. Co., 98 Union St.
Yonkers, N. Y.—Kipfer Engineering Co., 11 Nepperhan St.
Youngstown, Ohio—C. F. Erb, 722 Madison Ave.
Montreal, Canada—Pyke Motor & Yacht Co., 374 Notre Dame
Regina, Sask., Canada—Capital Welding Shop, 1762 Osler St.
Toronto, Canada—Ontario Motor Car Co., Ltd., 18 Bloor St.,
Windsor, Canada—L. Lawrence & Co., 41 Sandwich St., W.
Melbourne, Australia—A. Finlay Bros., 322 Elizabeth St.
London, England—New Welding Co.,.26 Rosebury Ave., E.C.I.

SCORED CYLINDER TRADE LAWRENCE MARK PATENT PROCESS

ESTABLISHED 1862

WOOLWORTH BLDG. **L. LAWRENCE & CO.** NEW YORK CITY

A FEW TERRITORIES STILL OPEN FOR LICENSEES

GASOL.

Gasol is a liquid hydrocarbon which turns into gas instantly upon release of pressure, which is automatically controlled by a regulator as the gas is used.

It is used for cutting steel (with oxygen), and for preheating operations, for paint removing and waterproofing; for heating, lighting and cooking in camps and country homes; in laboratories, plumbing, and repair shops and, in fact, wherever natural or artificial gas are not available, or where a specially hot flame is desired.

It is furnished in steel cylinders holding sixty pounds, or about fifteen gallons, of the material.

Cylinders, when empty, can be exchanged for full ones.

Freight shipments are made from the Pittsburgh, Pa., freight district and take third class commodity rates. Shipments can also be made by express.

The cylinders weigh 125 lbs. each with a possible variation of two or three pounds, more or less, making total weight of full cylinders about 185 pounds.

The Rockgas Products Company is equipped and prepared to furnish a large quantity of Gasol with prompt shipments and good service.

It can also furnish regulators, gauges, connections, fittings for the control and use of the gas; also burners and mantels for lighting and hot plates for cooking.

For cutting steel or preheating it is cheaper than acetylene or other compressed gases used for those purposes. For lighting it is cheaper than kerosene.

Gasol is composed of Ethane (C_2H_6), Propane (C_3H_8), and Butane (C_4H_{10}).

The following table shows some of its characteristics:

Boiling Point 40 below zero F.

Density of Gas 1.5 (Air = 1).

Number cu. ft. of gas per lb. of liquid 12.

B. T. U. per cu. ft. of gas 2500.

Vapor Tension (pressure of liquid on container at 70° F.) 150 lbs.

B. T. U.'s in each cylinder over 1,200,000.

Gasol has been used successfully for a number of years for the purposes above enumerated and new uses are constantly being found for it. It is made by the Rockgas Products Company, Standard Life Building, Pittsburgh, Pa.

THE "WHAT" AND "WHY" OF THE A. B. C.

The Audit Bureau of Circulations is an Association of Advertisers, Advertising Agents and reputable Publishers who are cooperating, with the object of standardizing circulation data, thereby placing the buying of space on a basis of known value.

It also aims to discountenance practices inimical to the interests of Advertisers and Publishers.

The Bureau was established in 1914, and now numbers among its members, applicants for membership, etc., thirteen hundred and seventy of the leading Advertisers, Advertising Agents and Publishers in the United States and Canada.

Its Board of Directors is composed of 11 National Advertisers; 2 Advertising Agents; 2 Newspaper, 2 Magazine, 2 Farm Paper and 2 Trade Paper Publishers.

Twice a year the Publishers make a report to the Bureau showing total circulation and details of distribution by states, cities, towns, suburbs and rural districts; also subscription rates and facts about contests, premiums and club offers. Once a year these statements are audited by one of the Bureau's experts.

Eighty-two per cent of the circulation of daily newspapers in the United States and Canada that have a circulation of 5,000 or over is audited and verified by the Audit Bureau of Circulations.

One hundred and sixty-four business publications are members of the A. B. C. They include the leaders in their respective lines. In some fields more than ninety per cent of the total circulation is verified by the Bureau.

The continent, from ocean to ocean, and from Hudson Bay to the Gulf of Mexico, can be covered without using a single publication that declines to give properly certified circulation data.

To confine appropriation to A. B. C. mediums, both for consumer and trade advertising, is sound business practice.

In this way can be crowned the efforts of the past five years of Advertisers and Advertising Agents and reputable Publishers to replace by system and certainty the fortuitous condition which obtained before the advent of the Audit Bureau of Circulations.

Persistence and insistence in demanding A. B. C. reports is the *only* method by which advertising will be placed finally on an exact basis.

The Welding Engineer is a member of the A. B. C.

SOLDERING

Editor: Having read your article on soldering, am writing a formula for a soldering solution.

The following gives the formula for a solution which is inexpensive to prepare and will be found a great improvement over the soldering acids generally used in machine shops. In addition to being an excellent soldering solution for brass, copper, tin and bronze, it may also be used as a flux for soldering galvanized iron. The union between the galvanized parts is perfect when this flux is used. The method of preparing is as follows:

Make a saturated solution of zinc chloride by dissolving as much zinc chloride as possible in water. Ammonium Chloride (ordinary sal ammoniac) is added to this, the quantity being 1/10 part by weight. The solution should be thoroughly mixed before using. A good paste for use where soldering acid would be objectionable is composed of the following ingredients: Ammonium chloride, 25 per cent: alcohol (wood or grain), 25 per cent: common vaseline, 50 per cent. The ingredients are thoroughly mixed before the paste is used.—Reader.

Mr. Harrison Bird, for the past five years connected with the Chicago branch of the Davis-Bournonville Co., has been appointed District Sales Manager at Detroit, to succeed the late J. Roy Wilson.

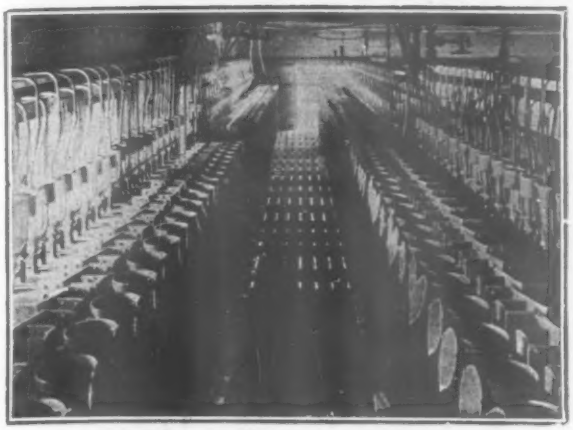
Classified Ads

Help Wanted—25c per line, minimum 4 lines.
Jobs Wanted—4 lines free.
Other Ads—50c per line, minimum 4 lines.
Count 8 words to line. Add 6 words for keyed address.

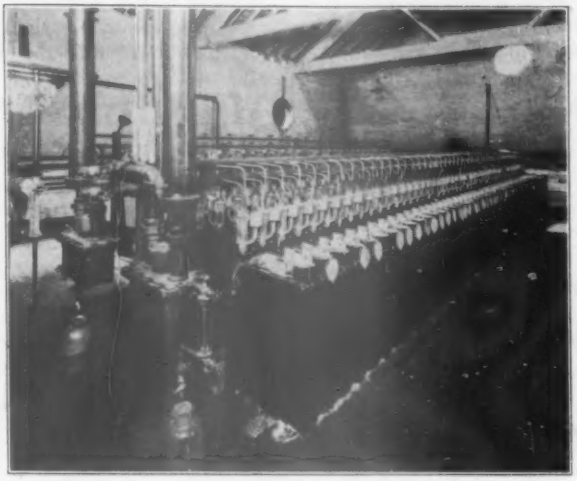
Wanted—Salesman to solicit subscriptions to *The Welding Engineer*, or furnish names of possible readers. Compensation good. Correspondence confidential. Write Mackenzie.

Oxy-Acetylene Operator Wanted: Must be capable of organizing welding shop and teaching new welders on high quality work. Give experience with oxy-acetylene and previous training, also compensation desired. Address Box L-175, care *The Welding Engineer.* 1t-Jan.

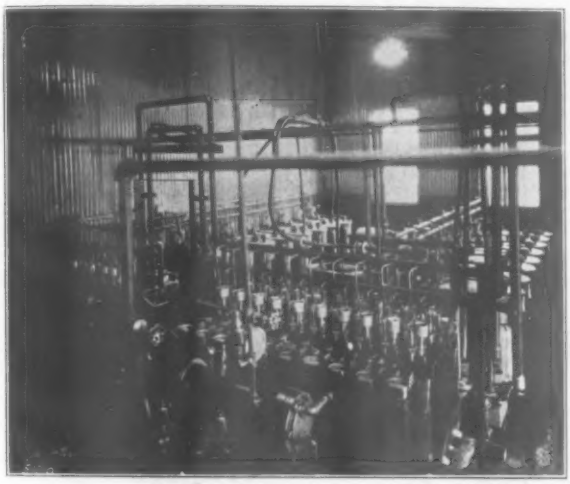
Demonstrating Welder and Service Man Wanted by Oxygen manufacturer operating in the East. Must be an experienced, competent man capable of carrying on demonstrations in result getting manner. Furnish full information in your first letter. Address 301, care *The Welding Engineer.*



Levin Cells at General Electric Co., Erie, Pa. First installation in foreground, second installation in rear. A Third installation of 100 recently purchased makes a total of 300 Levin Cells.



Cleveland Wire Division of the General Electric Co., Cleveland, Ohio, operate 300 Levin Generators.



Second installation in the plant of the Wheeling Moulding & Foundry Co., Wheeling, W. Va.

Second installation consisting of 300 Levin Cells for the Portland Oxygen and Hydrogen Co., Portland, Oregon. The first installation consisting of 100 Levin Cells.

FOUR STRONG RECOMMENDATIONS

The best recommendation in the world is a REPEAT ORDER.

The first installations in the above photographs were batteries of 100 cells. Each of these plants have either doubled or tripled their initial capacities.

We merely give these four illustrations as an expression of confidence that is placed in LEVIN CELLS to meet the tremendous output of these leading concerns. Smaller batteries of LEVIN CELLS have been enlarged, doubled and trebled. Not once has the LEVIN CELLS system been reduced.

We will be pleased to send you recommendations from smaller installations. Write to our engineers and obtain complete technical details. Ask where you can see LEVIN CELLS in operation.

THE ELECTROLABS COMPANY

15 WILLIAM STREET NEW YORK CITY

BRANCH OFFICES

Morris Building, Philadelphia Merchants Exchange Bldg., San Francisco

General Offices and Works
2655 Penn Ave.
Pittsburgh, Pa.

Electrolabs
ELECTROLYTIC GAS SPECIALISTS

Under the Technical Supervision of the Electrolytic Oxy-hydrogen Laboratories.

Wanted—Salesmen, experienced in welding and cutting apparatus and supplies. Experience in hydrogen particularly desired. Well established electrolytic company in the West. Give complete information with references and picture in first letter. The right man can grow with us. Railroad fare refunded to successful applicant. Address FEF, care *The Welding Engineer.*
T. F.

For Sale—The largest welding and radiator shop in the state. Cleared five thousand last year. A splendid opportunity for someone with a little capital and pep. If interested write "Opportunity," care *The Welding Engineer.*

Oxweld Generator—Left hand side of duplex low-pressure type with gasometer, 200 lb. carbide capacity. By adding right hand side will give 400 lb. carbide capacity, insuring continuous service. Machine is practically new. Price, $800 F. O. B. Providence. Rhode Island Welding Co., 25 Bath St., Providence, R. I.

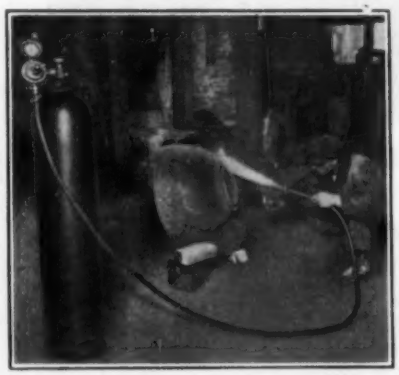
The United States Welding Company, Inc., report that during the latter half of 1919 the business of the company underwent a wonderful growth. This is explained by the fact that until about the middle of the year, Lieut. Lorn Campbell Jr. and Lieut. Cyrus K. Rickel, the guiding geniuses of this company, were in the service of their country and it was not until the latter half of the year that they were able to give their attention to business. The company is now settled in their new location at 120-122 North First Street, at which place they have a well equipped factory building and it is anticipated that the growth of the company thruout this year will be more rapid.

Capt. Geo. Fouser, Motor Transport Corps, is conducting a welding school for enlisted men at Camp Jessup, Atlanta, Ga.

Live Salesman Wanted

Experienced oxy-acetylene apparatus salesmen are wanted in Pittsburgh, Cleveland, Cincinnati and St. Louis. Only aggressive men who have made good need apply. These men are wanted to introduce and sell one of the finest constructed and efficient torches in the United States. The price is right and to the right men we will make an attractive proposition.

Give full particulars about yourself in first letter. Correspondence confidential. Address 289, care *The Welding Engineer.*



GASOL

Cheaper than any other compressed gas.

For
Pre-Heating
Brazing
Cutting
Welding
Cast Iron

Rockgas Products Company
Standard Life Bldg.,
PITTSBURGH, PA.

Our Fluxes take the Guess Work out of Welding

ALUMINUM
CAST IRON
BRAZING
COPPER

AMERICAN FLUX COMPANY
SALES AGENCY: P. O. Box 153, Mad. Sq. Station, New York City
FACTORY East Acton, Mass.

SALESMEN WANTED

To Represent the Welding Engineer and Solicit Subscriptions and Advertising During Spare Time—Write for Particulars. L. B. Mackenzie

Superior Brazing Compound

Send for Free Sample

A product of years of time and study. Over 98 per cent pure boron and is not attended by deposit or scale. Acts as a superior flux and purifies the brazing spelter, causing spelter to flow evenly into every part of joint, without deposit, scale or enamel. A trial will convince the experienced welder of the merits of Superior Brazing Compound.

Standard Mfg. Co
318 S. Canal St., Chicago

Continued from Page 52

polish good results one must not use a torch with a 90 degree head for boiler welding. A 35 or 45-degree head will help the welder keep the fused metal up and preheat in advance the edges to be welded. Success in boiler welding depends a great deal on the proper movement of the torch. It might be compared with the skillful movement of a piano-player. The longer the experience of the piano-player, the quicker and easier he is able to find the keys. It takes a great deal of time to get

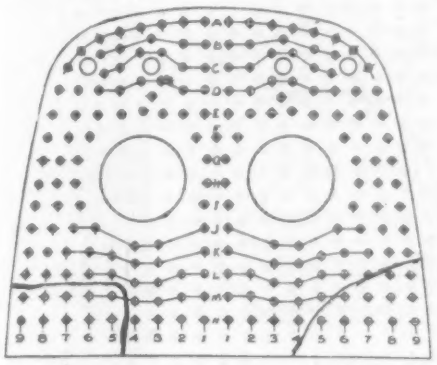


Fig 10

experience in boiler welding. An experienced boiler welder knows instantly when the flame has changed, the same as the experienced piano-player detects an improper sound in one of the keys. The welder knows the improper flame, not from the color or size of flame but from the color and nature of the fused metal; in an instant he has the flame adjusted again without stopping or causing any defect to the weld. An inexperienced welder will find his welding rod sticking too often to the plates, because he does not know when or how to apply the rod. An experienced welder will weld 20 feet of boiler plate and not once will he have his rod stick or chill to the plate.

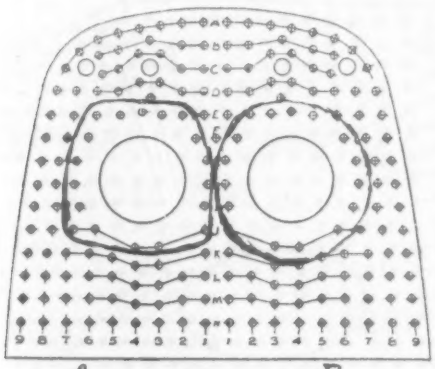


Fig 13

The author recommends the following advice to boiler welders:

1. Employ a torch with a 35 or 45-degree head.
2. Use a normal flame so the proportion of oxygen should not exceed much of the acetylene. An excess of oxygen contributes largely to the oxidation of the welds.
3. The small white jet should be without rigidity and should not sweep the fused metal. It should be as large as possible, provided the edges are sharp and clear.
4. The flame of the torch should be in contact with the metal, until the extremity of the white jet produces melting without too much exaggeration.
5. Welding metal should be added only when both edges are fusing and continued so until the weld is finished.

Treatment After Welding

The fused metal under the action of the gas flame consists of a crystalline mass whose grain is a hundred times larger than

Welders Moulding Compound

Actually

SAVES TIME
SAVES GAS
SAVES RODS

MAKES BETTER WELDS

Price per lb., with directions.....50c
(Sold in 5 lb. cartons only)

Manufactured only by
UNITED STATES WELDING CO.

Oxy-Acetylene **U.S.** Equipment

MINNEAPOLIS - MINNESOTA

WELDCO ONE MAN ---TRUCK---

Dealers!

Here is a profitable item of equipment —the New WELDCO Tank Carriage that puts the welding outfit on wheels.

Oxygen and Acetylene tanks are quickly and easily moved by a single operator. Does away with loading awkward gas cylinders on ordinary trucks, with the constant danger of knocking off valve stems. Right side up with care!—that's the WELDCO way.

Strong, practical and inexpensive.

Write for special dealers' proposition.

CAVE WELDING & MFG. CO.
"REGO" Equipment and Supplies
SPRINGFIELD MASSACHUSETTS

that of the neighboring metal. To change same into a finer grain which is very desirable, it is necessary to anneal the welding line immediately after welding. If there are corrugations or dished patches, it is necessary to heat them to cherry red so as to relieve any strain that may be in the weld.

vertical seams were welded on the door sheet as per figure 2 and same on the flue sheet as per figure 3. The last weld was made at the fire door as per figure 4.

Figure 5 shows side sheets crown and door sheet welded in a locomotive fire box. Great care was taken to keep the sheets

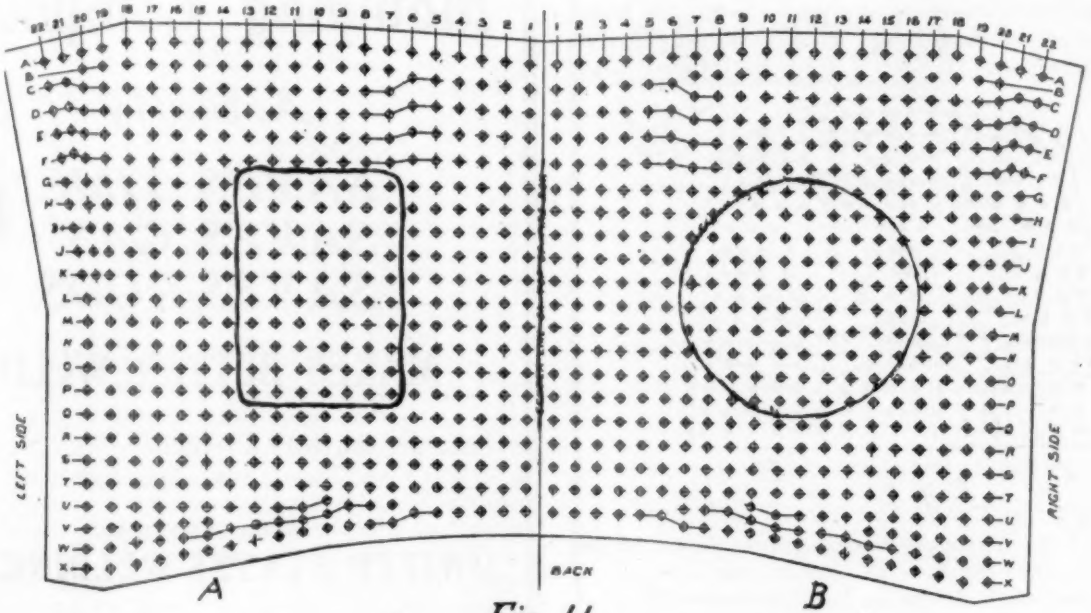


Fig 11

Applications

The application of the oxy-acetylene process of welding and cutting in the boiler shop has introduced in addition to the customary welding of side sheet patches, etc., a new operation.

level and the bevels before welding being separated at least ⅛-inch.

Figure 6A shows an undesirable method of welding a side sheet. There is no necessity of saving a little metal and instead of curving off the seam and creating a vertical weld

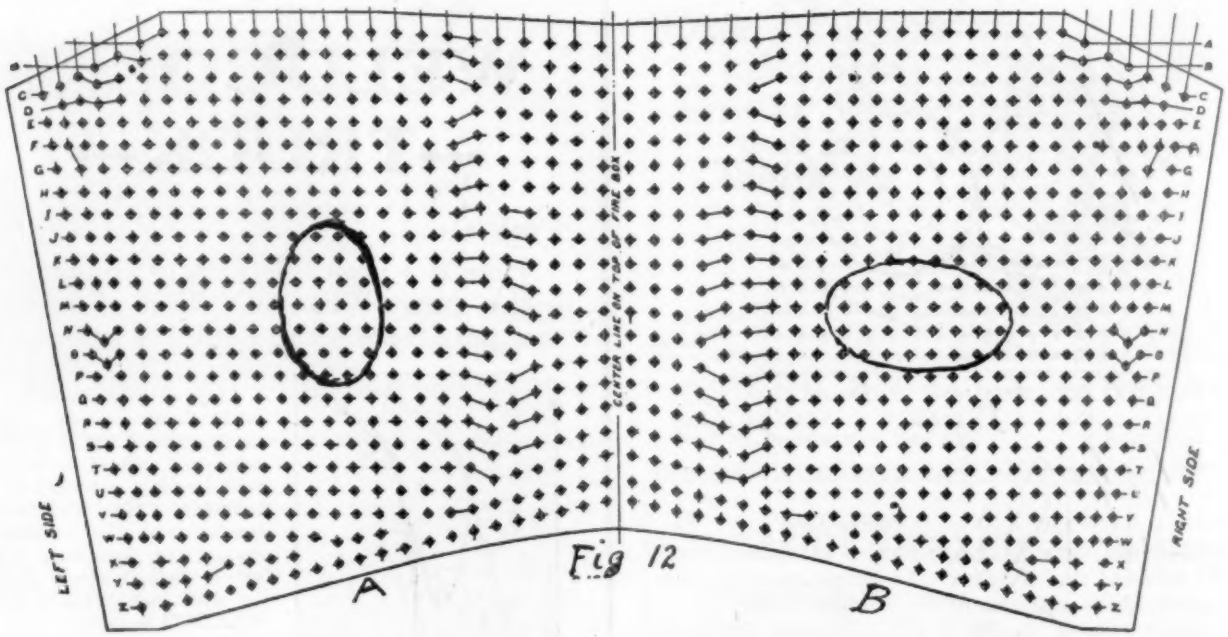


Fig 12

The Welding of Entire Fire Boxes

Figure 1 shows an old fire box partly cut out with the oxy-acetylene cutter. Stay bolts and rivets are cut out first, then the flues and seams last.

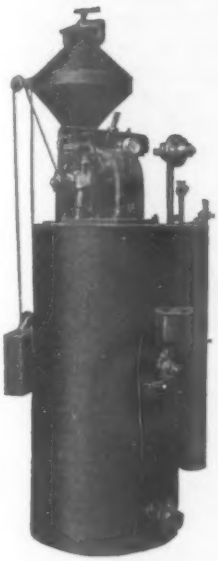
Figure 2 shows an entire fire box welded. Note the welds between the white paint marks. No rivets were employed on this fire box with the exception at the mud ring. The crown sheet was welded to the door, flue and side sheets, then the

down to the mud ring, it is cheaper and better to continue the horizontal line from flue sheet to door sheet.

Figure 6B is another undesirable method of welding a side sheet seam. Some boilermakers and welders are practising such seams at the expense of the owner, so as to save a little boiler plate. If the front end of the sheet is defective and the rear end is good, it is desirable to cut the sheet in a straight line across between staybolts at the highest mark of defection. Welded corners and curves in a side sheet will always set up

Acetylene 1¼c per foot

If you generate it with a



MECO

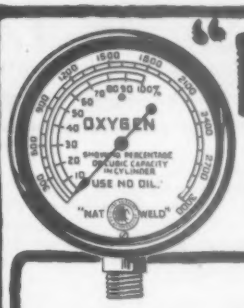
Type FG Portable Automatic Acetylene Generator

Made in 25-lb., 50-lb., and 100-lb. Capacity

Write for prices and literature

Modern Engineering Co.

23rd and Walnut Sts., ST. LOUIS, U. S. A.



"NATWELD" GAUGES

Independent Movement
Screwed on Rings
Non-ferrous Throughout

These features insure continued accuracy even during excessive vibration, temperature changes and rough handling. Send for sample set.

Look for the INDIAN HEAD *Trade Mark*

NATIONAL GAUGE & EQUIPMENT CO.
LACROSSE, WIS.

Kresge Bldg. DETROIT | 51 E. 42ND ST. NEW YORK | Railway Exchange Building CHICAGO

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FEDERAL TOOL & ALLOY STEEL CORPORATION

Genuine Swedish Charcoal Iron Welding Wire

Best Swedish Brands
Immediate Shipments From American Stocks

There is no substitute for Genuine Swedish Charcoal Iron on the score of quality

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654 W. Lake St., Chicago
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more or less strain, and as this could be avoided, it is best to do so. Furthermore, one must not weld a seam *below the fire line*. Always keep above the fire line, which is between 8 or 10 rows of staybolts high.

Figure 7 showing a straight line horizontal seam is the most desirable way of welding side sheets.

Figure 8 shows an undesirable method of welding a defective portion of a back head sheet.

Figure 9 is a better method of welding a patch above the mud ring and does not require more welding.

Figure 10. If a small portion of the door sheet or back head is corroded and patching is desired, Fig. 10B is a most desirable method of welding.

Fig. 10A is undesirable, because the corner is too sharp and there are more lineal inches to be welded.

Figure 11A is an undesirable method of welding a patch in side sheet.

Figure 11B is the proper method of welding a patch in side sheet.

Figure 12A and B is another desirable method of welding

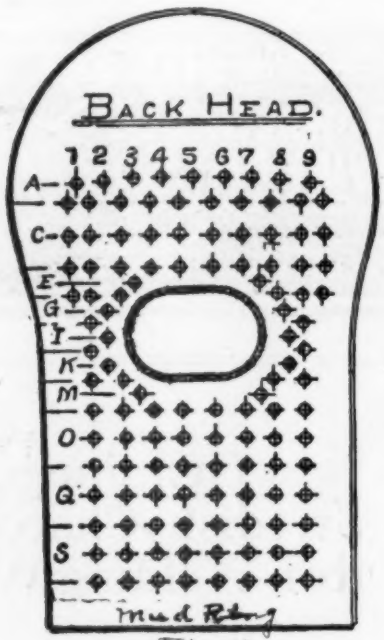

Fig 14

patches in case of cracks between stay bolts have been developed. These patches must be dished. The depth of the dish should be not less than the thickness of plate.

Figure 13A shows an undesirable method of welding a door collar.

Figure 13B shows the proper method of welding a door collar.

Figure 14 shows an undesirable method of welding and door hole, because it is lapped and welded. The best method in this case is to flange the door sheet level with the back head sheet and then butt weld both edges.

There has been in the past so many failures and poor welds made on boilers due to inexperience or to uncertainty of methods, that the continuance of such conditions will only harm the trade.

Help spread the truth about boiler welding. Every railroad and commercial boiler welder can render a distinct service, not only to the welding industry, but to the general public as well, by spreading abroad the success of boiler welding.

Recently a welder was sent to a small town to weld a cracked square fire door hole on a high-school boiler. His method was to secure a channel iron about four inches wide and bend it at the four corners so as to fit on top of the boiler plate. Then he welded the corners of the channel iron, laid it on top of the boiler plate and made lapped welds from inside and outside of the fire door hole. After welding it over and over again with continuous cracking at the welded corners, he finally gave up the welding torch and used a caulking tool to close the cracks, and somehow succeeded in proving to the janitor that the welds were tight. But very soon the school board found that they either had to put a new patch on or purchase a new boiler.

The writer got in touch with them and finally convinced the school board that he could make permanent repairs on boilers. My method was to cut out the channel iron, as well as the boiler plate on the door sheet and the back head sheet. The cuts were made in circular form, taking in one row of stay bolts. Then, two new round patches were made and flanged the *door hole round* instead of *square*. The patches were made out of fire box steel, the same thickness and buttwelded on door sheet and back sheet. At last the round circular joint was buttwelded and the writer was through with the job without using a caulking tool. After this operation the school board was so enthusiastic about welding that they desired to purchase some apparatus and teach the pupils the art of welding.

A welding firm welded a large bottom of an oil tank. The bottom was constructed of about 350 standard size $\frac{3}{16}$-inch and $\frac{1}{4}$-inch tank steel sheets, and were riveted at every joint. Most of these joints were leaking through the rivets and laps and it was the duty of the welder to weld this bottom mass of steel tight. His method was the old-fashioned way of welding on top of laps and rivets. Of course, these welds not only cracked open again but also warped the bottom up like the bottom of an imported brandy bottle. When this welder convinced himself that he had failed, to defend his failure, he stated to the engineer in charge of the tanks, that the sheets, being so old in service, had developed internal fractures.

The proper method the author would recommend in such a case is to cut out one row of sheets through the center of rivets, remove the top and bottom laps and then *butt* weld the sheets together. With this method, even if sheets did have internal fractures they would be safely welded without the trouble of cracking or warping.

Every railroad man remembers when a few years ago some welders of the Erie Railroad welded thousands of stay bolts to the sheet, so as to save replacing defective bolts, or enlarging the holes for larger staybolts. The result was that a Government Commission condemned at one time over 40 locomotives. Although the responsible men were punished, yet the welding trade experienced at that time a great shock, from which the trade is still suffering. Of course, at that time the welders blamed the process, and the Commission prohibited the railroad welding boilers. The writer's method is to remove all defective staybolts and, if the thread is worn or otherwise defective, to weld and build up the threads so as to be able to re-tap same holes to the standard size of bolts.

THE VILLAIN STILL PURSUED HER

Mr. C. R. Woleslagle, of El Paso, Texas, informs us of a very curious welding job. In most instances, the first requisite of a welding job is a sound weld. In this case, exactly the opposite was the case. Mr. Woleslagle was called on to weld a sword belonging to a stock company playing at a local theatre. The villain in the show meets the hero in deadly combat. As the integral parts of the hero are about to be scattered all over the stage the sword breaks—right where Mr. Woleslagle makes his weld. Very good Mr. W., but please confine your experiments to actors.

One of the Best and Most Economical Generators Manufactured

Manufacturers of
Welding and cutting apparatus
Lead burning outfits
De-carbonizing outfits
Welding torches
Cutting torches
Sheet metal torches
Battery torches
Acetylene torches
Regulators
Safety lighters
Carbon rods
Carbon paste
Gauges
Hose
Goggles

Electric and Oil Preheaters
Cast iron rods 24 in. long
Tobin bronze rods
Manganese bronze rods
Aluminum rods
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Superior Oxy - Acetylene Machine Co.

Our New England States Representative,
R. I. WELDING CO., Providence, R. I.

Hamilton, Ohio

Fyber-Weld GOGGLES for Welders

Fitted with "Essentialite" Lenses

Frame is made entirely of vulcanized fibre, and in addition to being light in weight is a non-conductor of heat and electricity, is non-inflammable and infusible, is not affected by moisture or perspiration and is easily sterilized and kept sanitary. Has flexible leather center, ventilated side pieces and adjustable elastic headband.

Prices as follows:

No. 510, fitted Essentialite lenses, No. 4 shade, for cutting and cover glasses.....$3.00 pair
No. 510, fitted Essentialite lenses, No. 6 shade, for welding and cover glasses.....$3.00 pair
No. 510, fitted with amber, smoked green or deep blue, cesco blue and cover glasses.$2.50 pair
Extra cover glasses in clear or amber tint..... .20 pair

"ESSENTIALITE" LENSES

To those of our patrons who are not thoroughly conversant with the real qualities and benefits of "Essentialite" lenses, we take pleasure in furnishing the following information. In placing the "Essentialite" before the trade, we have, after years of experimenting and research, succeeded in discovering the means of protecting the delicate organism of sight against the destructive Ultra Violet rays. We have demonstrated conclusively that with these lenses we vanquish the so-called "fatigue-weariness" and headaches caused by Ultra Violet and Infra Red rays.

Manufactured By **CHICAGO EYE-SHIELD CO., 2300 Warren Ave., Chicago, Ill.**

AUTOMOBILE WELDING

With the OXY-ACETYLENE FLAME By M. Keith Dunham

167 Pages **Price $1.50** *Fully Illustrated*

This is the only complete book on the "Why" and "How" of Welding

Explains in a simple manner apparatus to be used, its care, and how to construct necessary shop equipment. Proceeds then to the actual welding of all automobile parts, in a manner understandable by everyone.

Gives principles never to be forgotten. Aluminum, cast iron, steel, copper, brass, bronze and malleable iron are fully treated, as well as a clear explanation of the proper manner to burn the carbon out of the combustion head.

Automobile Owners, Garage and Service Stations, Blacksmiths and Machine Shops, as well as industries using the oxy-acetylene flame, will find this book of the utmost value, since the perplexing problems arising when metal is heated to a melting point are fully explained and the proper methods to overcome them shown.

CONTENTS

CHAPTER I.—APPARATUS KNOWLEDGE.
Oxygen Supply—Care of Oxygen Cylinder—Acetylene Generation—Care of Generator—Regulators—Care of Regulator — Creeping Regulators — Gauges—Care of Gauges—Welding Torch—Care of Welding Torch—Effects of Heat—Hose and Goggles.

CHAPTER II.—SHOP EQUIPMENT AND INITIAL PROCEDURE.
Preheating Agencies—Welding Table—Location of Welding Outfit—Starting the Welding Outfit—Adjustment of Flame—Principle of Welding—General Welding Knowledge—Welding Rods and Fluxes—Choice of Tip—Expansion and Contraction.

CHAPTER III.—CAST IRON.
Simple Welding—How to Hold the Flame—Hard Cast Iron—Pin Holes and Blow Holes—Lug on Cylinder—Water Outlet—Cylinder Welding—Compression Head—Finishing and Testing—Scored Cylinders—Cylinder Parts—Fly Wheels—Pistons—Crank Cases — Babbitted Bearings — Valve Guides—Preserving Threads—Conclusion of Cast Iron.

CHAPTER IV.—ALUMINUM.
Use of—Welding Knowledge—Puddle System—Flux System—Comparison of Systems—Welding Rod—Preparation of the Weld—Inlet Manifold—Arm of Crank Case—Welding the Arm Without Taking Out the Motor—Break in the Body of Case—Welding Cold —Wrong Method of Setting Up—Lug or Boss Welding—Preheating the Case —Gas Preheating Flame—One Side or Both—Collapse of Weld—Broken Bearings—Direction of Welding—Shrinkage Cracks—Missing Parts—Finishing—Die Moulded Castings—Body—Other Parts.

CHAPTER V.—STEEL.
Welding Knowledge—What the Flame Does to Steel—The Welding Rod—Simple Welding—Position of Flame—Reinforcing the Weld—Frame Welding—Lengthening the Chassis—Tube Housings—Worn Parts—Gear Welding — Case Hardening — Light Metal Welding—Gasoline Tank—Welding Adjacent to Rivets—Shaft Welding—Construction of Parts.

CHAPTER VI.—MALLEABLE IRON, COPPER, BRASS, BRONZE.
How to Detect Malleable Iron—Brazing Malleable Iron—Rear Housing—Reinforcing the Braze—Brazing Tube to Housing—Building Up Worn Parts—Copper—Brass and Bronze—Silver Soldering.

CHAPTER VII.—CARBON BURNING AND OTHER USES OF OXYGEN AND ACETYLENE.
Principle of Carbon Burning—Method of Operation—Lead Burning—Soldering—Case Hardening—Heating Uses.

CHAPTER VIII.—HOW TO FIGURE COST OF WELDING.
Oxygen Consumption—Dissolved Acetylene Consumption—Torch Consumption Test—Acetylene Generator Consumption—Cost Card—Conclusion.

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WELDERS

The Brotherhood of Gas and Electric Welders and Operators of America wish to get in touch with all workers at the trade throughout the United States. Important Information.

Address

C. B. Crawford

Corresponding Secretary

212 36th Street
EWPORT NEWS, VA.

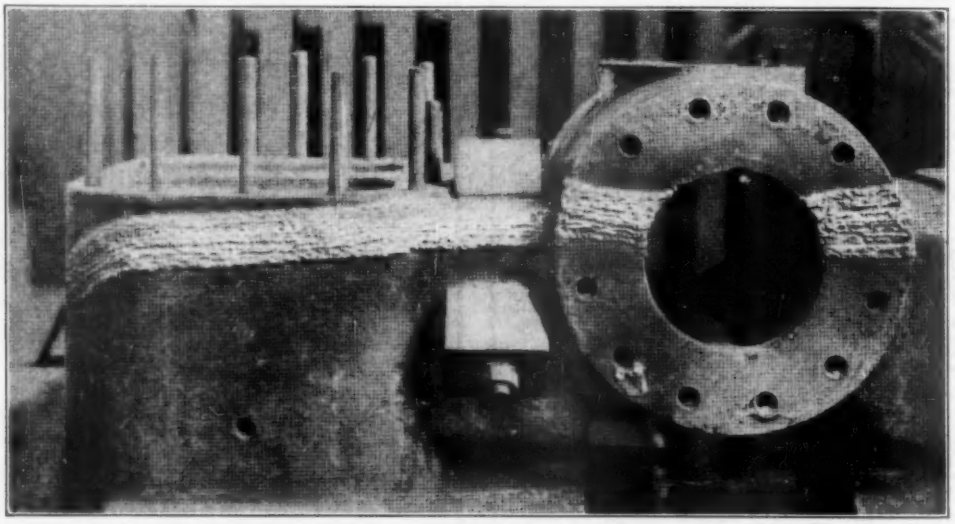
THE POSTAL ZONE LAW

By Senator Arthur Capper of Kansas

It has been argued that the postal zone increases apply only to the advertising sections of magazines. This is perfectly true as a statement of the mere words of the postal zone law. It is not true as a statement of facts. For a periodical or a newspaper is a unit from cover to cover. It is one unit of bulk that is never broken. The argument that the increased postage merely affects advertising is virtually the same as as if it were argued that the postal zone legislation had provided that the upper half of a magazine should pay postal zone rates and the lower half flat rates. It would be a mere bookkeeping separation that would not in the least affect the postage cost to the reader, for the reader—who is the ultimate consumer—takes the magazine as it comes, and the cost of the magazine is its cost as a unit, and its postage cost to him is its entire cost as a unit, no matter how ingeniously or intricately one may subdivide the component parts.

Advertising is the one great factor in modern wealth production that enables wealth to be distributed almost instantaneously; a generation or so ago the same result could not have been accomplished without years of hand-to-hand selling, and expensive, slow, personal salesmanship. Congress itself saw this, and when means of war taxation were being carefully discussed and every channel was being developed, it was deliberately decided that the destructive economic effects that would follow the taxation of advertising would be too great and too dangerous to attempt.

Exhibit of Air Reduction Co., at Atlantic City



Broken Feed Water Pump, Cast-Iron, Showing Method of Preparation for Bare Arc Welding

Now then, as to the allegations of the cost of transmission of this second-class matter through the mails. The figures upon which the absurd allegations of second-class deficits are made were compiled by the Postoffice Department in 1908 and 1909—eleven years ago! So unreliable were they even then that, when the U. S. Postal Commission, headed by the Hon. Charles E. Hughes, investigated them two years

PERFORMANCE---The Proof of Value

CUT YOUR COST

INCREASE YOUR PROFITS

WITH

KENTUCKY ACETYLENE GENERATORS

(HIGH PRESSURE TYPE)

MAKE YOUR OWN ACETYLENE AT LESS THAN HALF THE COST OF COMPRESSED ACETYLENE

Investigate Our Low Prices and Easy Terms

Let the Generator Pay for Itself While in Operation

Kentucky Acetylene Generators generate gas at a set pressure of from two to fifteen pounds—They're all welded—perfectly constructed—simple, most accurate automatic motor feed—compact rotary feed mechanism perfectly controlled—never failing—automatic safety control regulator.

Accurate Gas Pressure—No Fluctuation

Equipped with three separately operating automatic back pressure valves—automatic blow-off valve—perfectly constructed water seal and purifier eliminating all danger from flashbacks—producing pure acetylene, free from all foreign substances—Rego line regulators and U. S. gauges.

Made in Sizes of 25, 50, 100 and 200 lbs. Carbide Capacity.
Single and Double Units
Splendid Proposition for Jobbers and Distributors. Write Us Today.

KENTUCKY OXYGEN-HYDROGEN COMPANY

INCORPORATED

MANUFACTURERS OF OXYGEN AND HYDROGEN
Distributors of REGO WELDING AND CUTTING APPARATUS

Supply Department

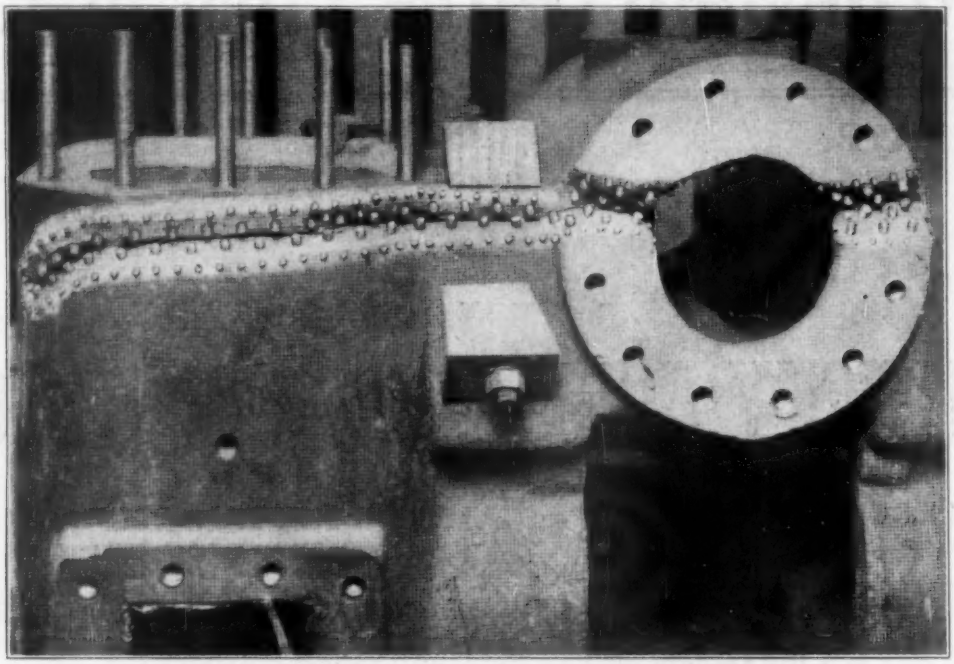
Complete line of welding, cutting, lead-burning equipment, welding rods and fluxes, preheating ovens and torches for gas, kerosene and electricity, cylinder trucks, welding tables, aerial grinders, chipping hammers, electric spot welders, electric A. C. arc welders, asbestos protective apparel, goggles, etc.

Special prices on double fabric rubber hose and copper armored hose. Write us. Get your name on our monthly mailing list.

Our Engineering Dept. Will Give Free Advice as to Lowering the Cost of Operation in Welding and Cutting

after their compilation, they were officially discredited as being no indication of what the costs were for the various divisions of second-class matter! Moreover, the Postoffice Department since that date has taken pride in stating that it has in enormous and basic ways cheapened the postal cost of second-class matter.

The most unfortunate part of this postal zone legislation is that it is an insidious and dangerous attempt to set back postal history seventy years and re-establish the universally condemned principle of postal cost determining the postal rates. It abolishes the sound postal principle of equal postage to all parts of our nation. The rural free delivery—one of the most vital and important postal functions—is conducted at almost a total loss, and if this vicious and unsound cost principle is once established, the demoralization of our splendid postal principles is only a matter of logic and time.



Broken Feed Water Pump, Cast-Iron, Welded with Bare Electrode from General Electric Equipment

Manufacturers of

SEAMLESS STEEL CYLINDERS

For:

Oxygen
Hydrogen
Blaugas
Butane

Interstate Commerce Commission Specifications

RIGHT PRICES—PROMPT DELIVERIES—SUPERIOR SERVICE

Wm. Wharton Jr. & Co., Inc.

[Founded 1859]

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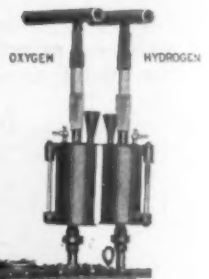
DISTRICT OFFICES:

Boston, New York, Scranton, Chicago, Philadelphia, San Francisco, Pittsburgh, Cleveland

Universal Oxygen Company

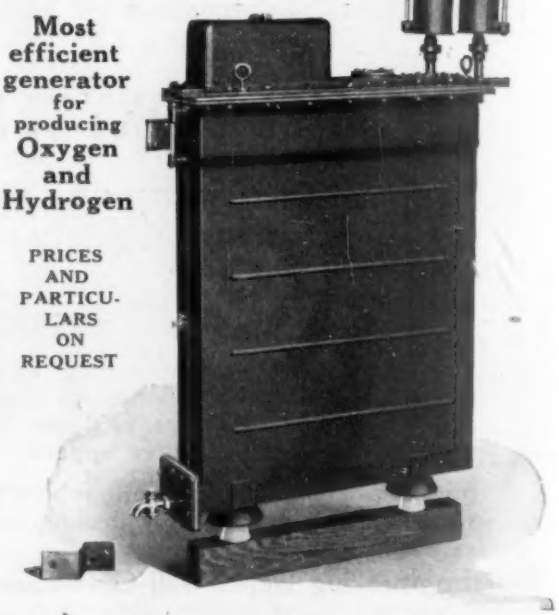
SHEBOYGAN WISCONSIN

MANUFACTURERS



Most efficient generator for producing Oxygen and Hydrogen

PRICES AND PARTICULARS ON REQUEST



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I. O. C. Generators will produce purest oxygen and hydrogen in any quantity in your own plant.

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The I. O. C. System is in operation in over 200 plants.

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IT'S especially made for you—for the welder, not for the casting. Not the ordinary paper manufactured for many uses, but a scientifically prepared, long-fibre, pure asbestos paper developed for one purpose—to furnish a welding paper capable of withstanding hard usage and high temperatures without giving off noxious and injurious smoke, gases and fumes. Your men naturally can do better work when WELDOX Asbestos Welding Paper is used on every welding job.

WELDOX Asbestos Welding Paper comes in 50 lb. and 100 lb. rolls, 36 inches wide.

Test the Free Sample with a torch. Subject it to physical tests. "WELDOX" in your shop and available for every job will save in many ways: It lasts longer; it cuts out eye and lung sore for the welders; it therefore aids in turning out better work in less time.

All rolls specially wrapped, and labeled "Weldox"

Asbestos Mittens, plain or one finger and thumb.
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Asbestos Masks.
Asbestos Fibres.
Asbestos Cloth.

If it's Asbestos, we have it.

F. D. Farnam & Co.

140 South Dearborn Street, Chicago, Ill.

Something New for Welders

Welders Moulding Compound

Every Oxy-Acetylene and Electric Arc welder has undoubtedly felt the demand for a fire resisting compound which could be moulded into any desired shape. When building up metal around holes in castings, and where welding is necessary thru a machined part, such as a bearing, much time and machining can be saved in addition to making a neater appearing job by employing such a compound. Carbon blocks and rods have their field, but it is very limited. "Welder's Moulding Compound" can not only be used wherever carbon has been, but it has a much wider field. Moulds can be made for any missing lugs or parts and new ones cast that have all the appearance of having been machined. Aluminum parts may be "backed-up" preventing the collapse of the metal when heating.

For aligning broken sections, whether large or small, the usual shimming process may be forgotten and much time saved by using this compound as a cushion for the work. It can be used in hundreds of different ways, over and over again—it don't wear out. The wide awake welder will appreciate its true worth.

5 lb. Boxes with directions for use.....$2.50

Manufactured only by

United States Welding Company, Inc.

Minneapolis, Minnesota, U. S. A.

U.S.

ALUMINUM SOLDER

ALLWELD

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OXYGEN, ACETYLENE and HYDROGEN REGULATORS

(With or without U. S. Gauges)

Approved by Board of Fire Underwriters

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Four Sizes: Nos. 30, 40, 50, 60
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Its value proven in the Old World
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THE WELDING ENGINEER
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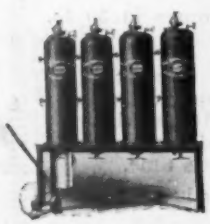

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OXY-ACETYLENE

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Guaranteed. Write for Catalog and Easy Terms
$25 to $250
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ACETYLENE OIL GAS PRODUCER, the gas of greatest efficiency, economy and SAFETY. The only class of its kind. Saves 25% on gas and oxygen.

FIRST CLASS REFERENCES
Special Welding MACHINES, guaranteed no flash back cutting and welding torches, and supplies.

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AIRCO OXYGEN
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AIRCO

IN PIPE WELDING

The joint produced by the Airco process of oxy-acetylene welding can be made as tight and as strong, or stronger, than the pipe itself. The cost is at least 30% less than the threaded joint.

The illustration shows an Airco operator welding two sections of sixteen inch steel pipe for use in the construction of an eight mile, all welded, gas pipe line.

AIRCO PRODUCTS

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ACETYLENE
WELDING AND CUTTING APPARATUS AND SUPPLIES
ACETYLENE GENERATORS
CARBIDE
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AIR REDUCTION COMPANY, INC.
NEW YORK

AIRCO SERVICE—A DISTRIBUTING STATION NEAR EVERY AIRCO USER

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Commercial Acetylene sets the highest standard of uniformity and dependability. It is perfected through a series of the most exacting scientific processes for purifying and drying, and is tested for quality every fifteen minutes during manufacture.

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Commercial Acetylene is sold in a seamless, one-piece cylinder, without welds or joints that permit leakage. The cylinder is **loaned** to you **without charge.**

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The character of the porous filler is most important for safey. It must not change or disintegrate, and must remain inert with acetylene and acetone. Since 1912, when the composite filler used in **Commercial Acetylene** cylinders was perfected and patented by this company, in no instance among thousands of cylinders tested has there been the least sign of deterioration.

Commercial Acetylene

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Commercial Acetylene Supply Co.

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